



NCDA&CS Plant Industry Division Annual Report 2017



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NORTH CAROLINA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES



Mission Statement

The mission of the North Carolina Department of Agriculture and Consumer Services is to provide services that promote and improve agriculture, agribusiness, and forests; protect consumers and businesses; and conserve farmland and natural resources for the prosperity of all North Carolinians.

Steve Troxler
Commissioner of Agriculture
Chairman, Board of Agriculture

North Carolina Board of Agriculture



Scott Tyson



Ben Shelton



Anne Faircloth



James Lambeth



Jose Calderon



John Carter



Jeffrey Turner



Faylene Whitaker



Doug Boyd

Franklin (Ray) Allen



Bob Sutter

CONTACT INFORMATION

Commissioner and Executive Staff

Steve Troxler	Commissioner	(919) 707-3000
N. David Smith	Chief Deputy Commissioner	(919) 707-3033
Joe Reardon	Assistant Commissioner	(919) 707-3009
Dr. Sandy Stewart	Assistant Commissioner	(919) 707-3015
Scott Bissette	Assistant Commissioner	(919) 857-4844

Director and Administrative Staff

Phil Wilson	Division Director	(919) 707-3732
Joy Goforth	Plant Protection Section Administrator	(919) 707-3753
Brian Bowers	Seed and Fertilizer Section Administrator	(919) 707-3735
Elizabeth Heath	Administrative Officer II	(919) 707-3731

Plant Industry Division

Plant Industry Division Web Site: <http://www.ncagr.gov/plantindustry/>

Facilities:

Plant Industry Division-Administrative Offices and N.C. Seed Laboratory

Physical Address: 216 West Jones Street, Raleigh, NC 27603

Mailing Address: 1060 Mail Service Center, Raleigh, NC 27699-1060

Support Operations

Physical Address: 1013 Blair Drive, Raleigh, NC 27603

Mailing Address: 1060 Mail Service Center, Raleigh, NC 27699-1060

Biological Control Services

Physical Address: 950 East Chatham Street, Cary, NC 27511

Mailing Address: 1060 Mail Service Center, Raleigh NC 27699-1060

Witchweed Program Facilities

Physical Address: 450 Smith Circle, Room 108, Elizabethtown, NC 28337

Mailing Address: Same as above

Physical Address: Agri-Expo Center, 301 Mountain Dr., Rm. 204, Fayetteville, NC 28306

Mailing Address: Same as above

Physical Address: O.P. Owens Agric. Center, 405 Country Club Dr. Lumberton, NC 28358

Mailing Address: Same as above

Plant Protection Section Accomplishments

Apiary Inspection and Biological Control Programs

The Apiary Inspection and Biological Control Programs have been based together in the Beneficial Insects Lab (BIL), located in Cary, NC since 1995. The primary mission of the Apiary Inspection Service is to maintain a viable beekeeping industry and ensure the productivity of North Carolina's diverse agriculture. The NC beekeeping industry continues to remain viable and is expanding, particularly with new hobby beekeepers. Our inspectors assist beekeepers through field inspections, educational meetings, and field days and attempt to be available to assist the beekeepers in any way necessary. Our goal is to further improve our overall inspections and, ultimately, to reduce the rate of honey bee disease and pest problems.

The mission of the biological control program is to manage exotic pests using ecologically-based methods. We focus on classical biocontrol, reuniting exotic pests with the natural enemies that keep them below damaging levels in their home ranges. Although we are primarily an implementation program, conducting these projects requires research to ascertain the appropriateness of releasing biological control agents or to follow up on agents released. Currently, our projects focus on a variety of exotic insects and weeds, and involve laboratory rearing of insects, field releases of natural enemies, and surveying. Our quarantine facility remains useful to our division as well as to outside cooperators as a secure space for research and monitoring of pests. Personnel working in the program during 2017 included Steven Turner, Biological Control Administrator, Christine Nalepa, Research Specialist, and Nancy Oderkirk, Research Specialist, quarantine officer, and safety officer. Temporary part time Biological Control Program staff included John Wilson and John Banask (both hired November 2017). Glenn Hackney is a Research Specialist in the Apiary Inspection Program and maintains a lab at the BIL. Other Apiary staff are based at their homes across the state. During 2017, the inspectors were: Greg Farris, western Piedmont, Nancy Ruppert, Sandhills, Will Hicks, NE central counties, Adolphus Leonard, Coastal Plain, Lewis Cauble, mountain territory, and Don Hopkins, NW central counties, State Apiarist and Apiary Inspection Supervisor.

Apiary Inspection Program

To protect the health of our honey bee industry, permits to sell bees are required for anyone wishing to sell queens, package bees, nucs, or hives. In 2017, 134 permits were issued to sellers. To obtain a permit, bees must be inspected and the producers agree to comply with standards designed to maintain healthy colonies. Beekeepers are strongly encouraged to buy only from permitted dealers to avoid buying unhealthy or Africanized honey bees.

One of the most devastating and difficult to control bee diseases is American foulbrood (AFB). We are encouraged to see that our AFB incidence remains below 1%. We have maintained the Special Local Need 24(c) registration for the ethylene oxide (EtO) fumigation chamber as well as a source of the EtO formulation. We are currently providing decontamination service to the beekeepers of North Carolina with the chamber, and it is our belief that it is a valuable tool in controlling AFB as well as other serious pests and diseases.

The mite *Varroa destructor* persists as a major threat to the beekeeping industry in NC and is probably a contributing factor to general poor health or mortality of bee colonies. Several new miticides have been registered; however, the mites have developed resistance to some of these materials in short order and rendered these products ineffective. Currently, the list of registered products for *Varroa* control in North Carolina includes Apistan®, CheckMite+®, Api-Life Var®, Apiguard®, Mite-Away Quick Strips®, Apivar®, oxalic acid (specifically labeled for bees), and HopGuard®. All of the aforementioned products are listed in North Carolina as Section 3 general use pesticides. Although chemical treatment of mites may be necessary, some miticides have been demonstrated to have adverse effects on bees. The growing use of unregistered materials also may have adverse effects on honey bee health and may not be efficacious in controlling mites. This and, in some cases, the improper use of antibiotics to control diseases can further complicate useful treatment regimes.

Beekeepers are expressing concerns about pesticides, particularly the neonicotinoids. Bee yards can be registered through the Plant Industry Division. This list is sent to Aerial Applicators licensed in NC. The NCDA&CS Apiary Inspectors have developed a good working relationship with the Structural Pest and Pesticides Division of the department. The Pesticide Division responds to reports of acute bee losses and follows up according to the evidence. If a pesticide problem is suspected, timely reporting to an Apiary Inspector or the Pesticide Section is crucial for a valid investigation and resolution. Apiary personnel have collected pollen samples from colonies suspected to be suffering sublethal effects of exposure to neonicotinoids. To date, the samples have contained no detectable levels of these chemicals. The Structural Pest Control and Pesticide Division and the Plant Industry Division are working with EPA to develop a Managed Pollinator Protection Plan.

Another threat facing the beekeeping industry of North Carolina is the establishment of Africanized honey bees (AHB) (*Apis mellifera scutellata*) in southern Florida (and finds in Georgia). We are maintaining swarm traps at the ports of Wilmington and Morehead City in order to intercept any bees coming in via ship. We hope to expand this trapping system to some of our land-based points of entry. We continue to engage in an outreach program to NC emergency response personnel to familiarize them with the potential threat of AHB. We are actively collecting samples of bees (particularly those from colonies with overly defensive behavior) to determine their geographic origin and their propensity for this behavior. The NCDA&CS and NCSU are collaborating in conducting this survey. At this time, none of the samples collected have been determined to be of the AHB type. We are striving to have our inspectors and our lab prepared to deal with any AHB incursion or incident. **We encourage beekeepers and the general public to please let us know of any colonies that seem to be displaying any unusual behavior, especially excessive defensiveness. We want to maintain a beekeeping industry in North Carolina that is not threatened by the reputation of this more defensive type of bee.**

Honey bee viruses are an issue that seems to be a growing concern among beekeepers. Currently, we do not have the capacity to provide a diagnostics service for viruses; however, we continue to enjoy a good working relationship with our friends in NC State University Apiculture Research and Extension Program. We hope to be able to add a capacity to do some of the molecular diagnostics that they are developing. We have had the opportunity to assist them in some of their projects and would like to express our gratitude for their assistance in many of our projects.

Implementation of *Cerceris fumipennis* as a Biosurveillance Tool for Pest Buprestidae in North Carolina during 2017

The solitary ground nesting wasp *Cerceris fumipennis* continues to be utilized as a biosurveillance tool for the efficient collection of pest buprestid beetles in several locations in the eastern and central United States. In 2017 studies of the wasp in North Carolina were continued in partnership with the Cooperative Agricultural Pest Survey (CAPS); we conducted biosurveillance at established sites and surveyed for new sites between 18 May and 16 July 2017.

Biosurveillance was conducted in 20 sites in 18 counties (Table 1). There was a resurgence of *C. fumipennis* activity in some sites from previous years that were rechecked (Havelock MS, Polk MS); others with historically high activity declined this year (Meadowview MS, Swain Veterans Park). Liberty Hill, Crossnore, and Brad Ragen Park are sites where *C. fumipennis* aggregations were detected in 2017 for the first time. Seven surveyed sites were unsuitable for biosurveillance (Table 2).

A total of 694 beetles were collected using biosurveillance with *C. fumipennis* in 2017. The first beetles collected were from Roberson Co. on 18 May and last beetles were taken on 16 July in Avery Co. We met our goal of 50+ beetles in 7 of the sites.

More than a quarter (26.5%) of collected beetles were in the economically important genus *Agrilus*; those *Agrilus* identified to species (by Whitney G. Swink) include *A. arcuatus*, *bilineatus*, *ferrisi*, *obsoletoguttatus*, *quadriguttatus*, *quadriimpressus*, *ruficollis*, and the emerald ash borer *A. planipennis*. *Cerceris* collected two buprestid taxa new to our collections in NC: *Acmaeodera ornata* (Bradford Pool, Roberson Co.) and *Texania campestris* (Havelock MS, Craven Co.). Species level identification is still pending for 146 beetles; these were sent to cooperator Joshua Basham from the Tennessee Department of Agriculture.

In 2017, emerald ash borer (EAB) was collected in four sites (Table 1), all in the mountains. In three of these sites, EAB was first collected in 2016 (Vance Elementary, Mountain Heritage High School, and Swain Co. Veterans Park). At the fourth EAB site, Liberty Hill in Mitchell Co., biosurveillance was conducted for the first time this year. In two sites where we detected EAB in previous years, no EAB were collected in 2017: Franklinton Park (EAB collected 2015), and Faith Christian Academy (EAB collected 2016). Vance Elementary in Buncombe Co. had the highest proportion of beetles in the genus *Agrilus* (67%); EAB made up half of the total beetles collected at the site. Overall, 10.7% of beetles collected in 2017 were EAB. There were no new county records of EAB that resulted from our biosurveillance, but our collection in Mitchell Co. occurred about two weeks after one was collected in a trap.

Among the buprestids collected in 2016 and subsequently identified by cooperator Joshua Basham, one of note is *Dicerca juncea*, not previously collected by *Cerceris* in NC. A few 2016 identifications are still pending.

The Cascade Lake site in Transylvania Co. is of particular interest for two reasons. First, it illustrates how prey selection by *C. fumipennis* can vary over time. Nearly all buprestid prey (15 of 16: 94%) were hemlock borers (*Phaenops fulvoguttata*) during the first collection at the site (28 June 17). During a subsequent visit on 10-11 July 17, no hemlock borers were among the 37 beetles collected. Second, it is a good example of nest site sharing by *Cerceris* spp. Nests of the weevil-hunting wasp *C. halone* were intermingled with those of *C. fumipennis* at this roadside aggregation. The nests of the two wasps are

similar looking, and the females are difficult to tell apart when bringing in prey. Consequently, 53 Buprestidae and 16 weevils were collected from females flying into the aggregation. The weevils were submitted to Matt Bertone at North Carolina State University for identification, along with 24 weevils collected from an additional 5 sites.

Table 1. Biosurveillance conducted for pest Buprestidae with *Cerceris fumipennis* in 2017

Site #	Site Name	County	Total Buprestidae	No. EAB	% EAB
1	Bradford Pool	Roberson 11	31	0	
2	Faith Christian Academy	Wayne 16	30	0	
3	Lake Lynn	Wake 42	41	0	
4	Havelock Middle School	Craven 1	31	0	
5	Seaborn Rd.	Jones 1	2	0	
6	Franklinton Park	Franklin 6	86	0	
7	Luddy Park	Franklin 4	55	0	
8	McCray	Alamance 14	44	0	
9	Aaron B Cherryville	Gaston	11	0	
10	Black Mtn Vets Park	Buncombe 33	5	0	
11	Vance Elementary	Buncombe 12	91	46	50.5
12	Polk Co. Middle School	Polk 2	78	0	
13	Cascade Lake	Transylvania 1	53	0	
14	Mountain Heritage HS	Yancey 2	52	19	36.5
15	Liberty Hill	Mitchell 8	61	5	8.2
16	Crossnore School	Avery 1	12	0	
17	Brad Ragan Park	Mitchell 9	1	0	
18	Caswell Co. Parks & Rec	Caswell 2	2	0	
19	Meadowview MS	Surry 5	1	0	
20	Swain Co. Veterans Park	Swain 2	7	4	57.1
TOTALS: 20 sites		18 counties	694	74	Overall: 10.7%

Table 2. Sites surveyed/resurveyed: unsuitable for biosurveillance with *C. fumipennis*

	Site	Date Surveyed	Results
1	Orange 8 – 2016; Ruritan Club	3 July 17	0 nests
2	Watauga 1 – 2010; Old Watauga HS	11 July 17	0 nests
3	Avery 7 – 2017; Avery Co. Parks & Rec	11 July 17	0 nests
4	Mecklenburg 24 – 2014; Trinity Church	14 June 17	10 nests, 1 beetle fragment
5	Alamance 22 – 2014; Hawfields MS	13 June 17	7 nests, 0 beetles
6	Cabarrus 14 – 2017; Mt. Pleasant MS	14 June 17	0 nests
7	Caswell 1 – 2012; Bartlett Yancey HS	6 July 2017	Field inaccessible

One paper was published in a scientific journal and another submitted during 2017:

- Nalepa, C.A., R.S. Norris and W.G. Swink. 2017. Collection of emerald ash borer by *Cerceris fumipennis* in North Carolina: case study at one nesting site. *Journal of Entomological Science* 52: 1-8.
- Nalepa, C.A., W.G. Swink and J. Basham. 2018. Body length is inconsistently related to body mass in Buprestidae (Coleoptera). *The Coleopterists Bulletin* (submitted).

Acknowledgements

Sue Dial, Larry Green, Mike Hodges, Christine Nalepa, Nancy Oderkirk, David Pearce, Michelle Shooter and Whitney Swink participated in the 2017 *Cerceris* survey by conducting biosurveillance, scouting new sites, and/or identifying beetles.

Hemlock Woolly Adelgid Predator Rearing at the Beneficial Insects Laboratory

Biocontrol often plays a critical role in integrated pest management (IPM,) which has become increasingly important as a practical method in large-scale ecological restoration efforts. Among the range of projects at the BIL, we operate a rearing facility to provide biological control agents for the management of hemlock woolly adelgid (*Adelges tsugae*).

The hemlock woolly adelgid (HWA) is now ubiquitous throughout the native range of both Eastern and Carolina Hemlocks, and degradation of hemlock stands by this pest is causing major ecological changes in those areas. Dead and dying trees also pose fire and safety hazards. Thus, chemical control measures have been undertaken in several locations by targeting carefully-chosen trees in specific areas of our parks; however, control with insecticides would be impractical and not economically feasible on a broad scale. Enter biocontrol! The predatory beetles *Sasajiscymnus tsugae* (St), native to Japan, and *Laricobius* species, native to Japan and to the Northwestern United States, are specialist predators that feed only on adelgids. Their lifecycles are synchronized with that of their adelgid host. Adelgids enter summer dormancy as early stage nymphs; in response, the beetles enter reproductive dormancy. As the adelgids break dormancy in the Fall, their predators resume their activities.

Because hemlock stands are scattered across wide areas, our biological control strategy is to make point releases of large numbers of predator beetles in carefully-selected sites, from which the beetles can multiply and eventually spread. The orchestrated use of targeted chemical control along with biological controls in a complementary fashion is a perfect example of IPM.

Predatory St beetles have been in production at the NCDA&CS BIL for fifteen years. We have ceased production of St beetles, and have started a colony of *Laricobius*, which we believe will offer complementary and more efficient HWA control. Our new *Laricobius* colony originates from beetles field-collected in Western North Carolina.

We will follow a rearing protocol developed by the Beneficial Insect Labs of Virginia Tech and the University of Tennessee. Beginning in December, beetle colonies will be established and refreshed biweekly with adelgid-infested hemlock. Oviposition jars will be set up weekly. Hemlock material with

adelgids and beetle eggs are moved from the jars to rearing cages, from which mature larvae are transferred to pupation chambers. Emerging beetles are collected several weeks later and moved into storage cages. Production peaks between December and April, i.e., as the adelgids fatten up and fill with eggs to feed the beetles. The whole project slows down during the summer dormancy of newly-hatched adelgids. We then maintain beetles in storage, to begin the process again each fall.

We maintained our former St colony by collecting adelgid-infested hemlock branches from North Carolina State Parks, most notably Hanging Rock State Park (HRSP,) about every two weeks. We regularly detect and remove naturally-occurring predator larvae from the collected hemlock, but beetle larvae have been relatively rare at the Hanging Rock site (though common elsewhere.) It is for this reason that we collected mostly at HRSP, and why we chose this site for our first predator release of the year. All chosen hemlock stands have been densely infested with HWA, but are relatively remote and in untreated areas.

We released more than 2700 St beetles in 2017, as follows: 1200 beetles were released on April 20th along Campground Road at HRSP Moore's Spring site, at coordinates 36.423, -80.288 (250 beetles) and 36.423, -80.283 (960 beetles) at an elevation of 850-900 feet. Our second release, on May 9th, introduced more than 500 beetles at South Mountains State Park (SMSP.) The site coordinates along Jacob's Fork are 35.597, -81.614 to 615, at an elevation of 1240 feet. We released an additional 100 beetles at HRSP on November 2nd, in the vicinity of the original release, then released 200 beetles on November 15th at Window Falls, HRSP, at 36.401, -80.2597, elevation 1400 feet. Finally, we released 725 beetles on Nov. 16th at SMSP along the River Trail along the West bank of Jacob's Fork, from 36.602, -81.628 to 35.599, -81.627, elevation 1300 feet.

Our hope is that the released beetles will develop into established colonies that will expand throughout each area. We are optimistic that these and future, complementary releases will play a significant role as part of the IPM program for HWA management in our State Parks. More information is available at NC State Parks in a brochure titled "Predators of the Hemlock Woolly Adelgid: Biological Control Offers New Hope for Hemlocks."

Acknowledgements

Production of HWA predatory beetles at the BIL has been supported by the USDA-APHIS, the US Forest Service, NCDA&CS, NC State Parks, and other collaborating agencies and organizations. The recent St colony originated from beetles supplied by Patrick Parkman of the Lindsay Young Beneficial Insect Lab of the University of Tennessee. Our new *Laricobius* colony originates from beetles field-collected in Western North Carolina. Our 2017 HWA biocontrol project was conducted by Steven Turner, Biocontrol Administrator, and Nancy Oderkirk, Research Specialist. We welcome John Wilson, Research Specialist, as director of the *Laricobius* project.

2017 Mile-A-Minute Vine Biological Control Report

Mile-a-Minute vine (MAM), *Persicaria perfoliata* (aka *Polygonum perfoliatum*,) is a fast-growing annual invasive weed found in riparian areas and along forest edges in the Eastern region of the United States. This plant was first discovered in this range in the mid-1930s. MAM is easily identified by its triangular leaves, spines on the reddish-colored stems and leaf petioles, and a modified leaf (ochrea) that surrounds each node of the vine. Its small white flowers develop into bright metallic blue, berry-like fruits. Seeds can remain viable in the soil for up to 6 years. They spread by floating great distances and

are dispersed by seed-feeding birds and mammals. Patches of MAM also travel along waterways during major flooding events.

Rapid growth, prolific flowering, long-lived seeds, location along riparian areas, and ability to overtop herbaceous and shrubby plants (Fig.1) and even small trees, make chemical control of MAM difficult. Cultivation is ineffective, because seeds are released during the process, and plant remnants root at the nodes and re-grow. Biological control has therefore proven to be the most practical strategy for dealing with this weed in many cases.

Surveys for natural enemies in its native Asia revealed the weevil *Rhinoncomimus latipes* Korotyaev as the most promising species, with MAM as its sole hostplant. This insect has since been reared at the Philip Alampi Beneficial Insect Lab (PABIL) of the New Jersey Department of Agriculture, which has



Figure 1. Mile-a-Minute vine overgrowing other vegetation. Adult weevil damage can be seen on the foliage. Alleghany County weevil dispersal site, 2015.

provided weevils for release throughout the Northeastern and Mid-Atlantic states, including North Carolina. Hough-Goldstein et al. (2008) provide an overview of the biology and biological control of MAM.

Delimiting surveys were initially conducted to determine the extent of MAM infestations throughout the known and expected range in North Carolina. Since the initial weevil releases, sites have been visited at least annually, and additional surveys have determined ongoing expansion of the weevil's range.

Mile-a-minute vine is widely distributed across the northern part of NC, from the mountains to the coast (Fig. 2.) Infestations vary in density and size, from small patches to dense thickets. Alleghany, Gates and Pasquotank Counties contain the most numerous and dense streamside and roadside infestations discovered to date.

Weevils have been released in multiple years at sites with dense MAM populations, resulting in 25 unique sites in 6 counties over a period of 7 years (Table 1).

Table. Releases of *Rhinoncomimus latipes* in NC by year.

Year	County	# Weevils	# Locations
2011	Alleghany	2200	6
	Yancey	200	1
2012	Alleghany	4800	6
2013	Alleghany	2500	3
2014	Alleghany	300	1
	Guilford	200	1
	Pasquotank	4000	5
2015	Gates	3000	6
	Rockingham	1350	3
2016	Pasquotank	300	2
	Rockingham	300	1
2017	Alleghany	2000	1
	Gates & Pasquotank	500	2
Totals	6	21,650	22 (unique)

Weevils have persisted at all release sites for one or more years after release, and dispersal of almost 5km from release sites has been documented (Fig. 3).

The initial Yancey County infestation was small and appeared limited in area. Weevils are considered established there after overwintering for at least three years, and in 2014 they were found up to 3km away from the release site. In 2015, no plants were found at these locations. Weevils might not account solely for the disappearance of the plants. Other factors, including late frost or early season mechanical or chemical control, contribute to the relative scarcity of MAM in some locations.

In the timberland of the northeastern counties, MAM populations line the drainage ditches that cross fields as well as covering harvested fields. Weevils have been recovered annually at and near previous release sites.

Rockingham County has variable MAM populations along the Mayo and Dan Rivers, popular recreational rivers crossed by multiple power lines. The rights of way under these provide easily invaded habitat, and seeds are readily distributed by water and wildlife.

The Guilford County infestation has been detected at only one site at this time. Weevils have persisted for two years at this location, despite major disturbance due to highway construction.

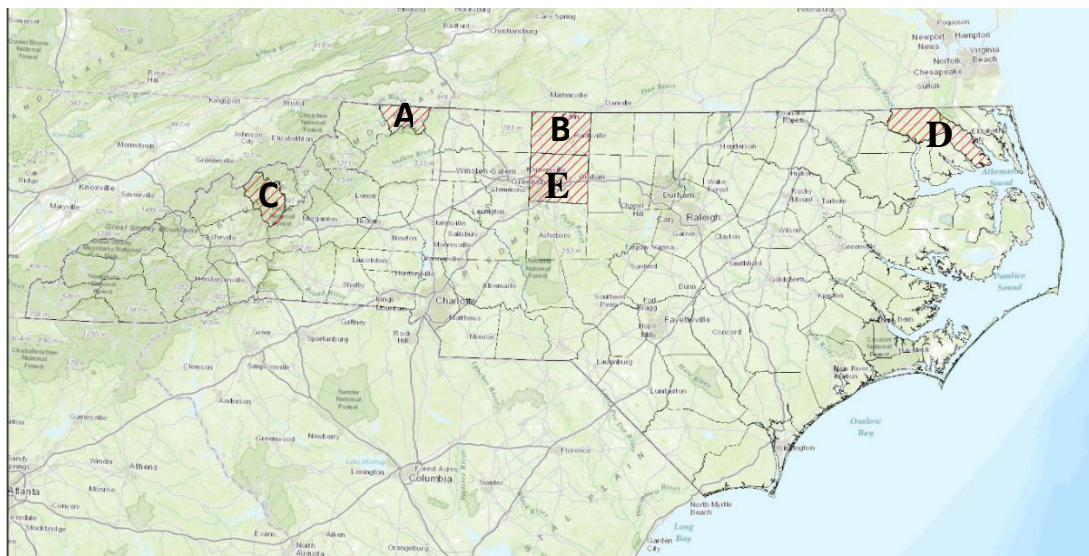


Figure 2. Mile-a-Minute infestations in North Carolina. Counties with hatch markings are infested. Letters correspond with the order in which county infestations were reported. A = Alleghany, B = Rockingham, C = Yancey, D = Pasquotank and Gates, E = Guilford.

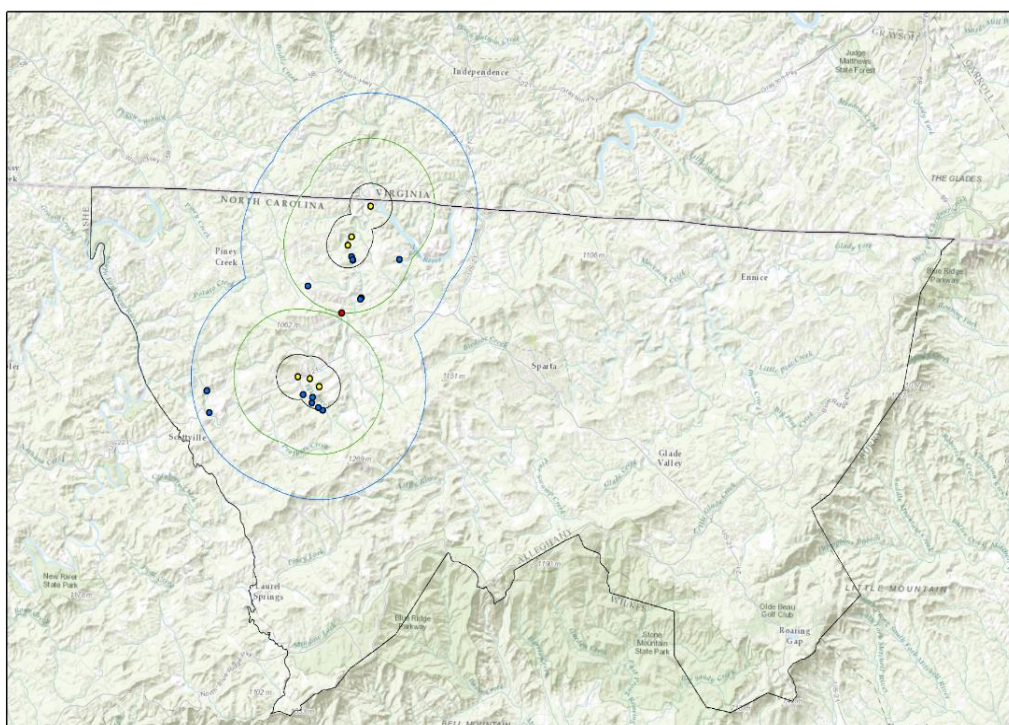


Figure 3. Alleghany County weevil releases and dispersal. Yellow = weevil release site, blue = weevil recovery, red = MAM infestation, no weevils recovered. Buffer zones represent 1 (black), 3 (green), or 5km (blue) from release sites.

Mile-a-minute vine, *Persicaria perfoliata* is found in six or more counties in North Carolina, and in habitats ranging from mountain valleys to the coastal plain. The biological control agent *Rhinoncomimus latipes* appears to be well adapted to a variety of habitats in the state, and has overwintered one or more years. Beetles have established and have dispersed from release sites. These results are similar to those found in areas to the north, where weevils dispersed at rates of 125m to 3.5km per year (Hough-Goldstein et al. 2009). As weevils multiply and continue to disperse, we expect to see increased foliar damage, decreased seed production, and reduced stands.

Because MAM weevils have reliably persisted and dispersed from release sites, we are actively planning to increase the supply by establishing a colony here at the NCDA Beneficial Insects Lab. We have adapted the methods of Hough-Goldstein et al. (2008) to maintain plants in growth chambers, and anticipate the production of a robust laboratory colony in the coming years.

Literature Cited

Hough-Goldstein, J., E. Lake, R. Reardon, and Y. Wu, 2008. Biology and Biological Control of Mile-a-minute Weed. USDA Forest Service, FHTET-2008-10.

Hough-Goldstein, J., M.A. Mayer, W. Hudson, G. Robbins, P. Morrison, and R. Reardon. 2009. Monitored releases of *Rhinoncomimus latipes* (Coleoptera: Curculionid), a biological control agent of mile-a-minute weed (*Persicaria perfoliata*), 2004-2008. Biological Control. 51:450-457.

Poindexter, D.B. 2010. *Persicaria perfoliata* (Polygonate) reaches North Carolina. Phytoneuron. 30: 1-9.

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Phorid Flies for Biological Control of the Imported Fire Ant, *Solenopsis invicta*, 2017

The Imported Fire Ant (IFA), *Solenopsis invicta*, was discovered in North Carolina in 1953. Since that time, it has spread to all but the northcentral and mountain regions (NCDA&CS, 2017). Its painful sting can harm humans, pets, and livestock. This ant is detrimental to agricultural productivity due to its effect on livestock as well as its deterrent effect on the production and harvest workforce, and reduces the marketability of agricultural products such as sod. In an effort to slow its spread and to decrease population size, biological control measures have been undertaken across the Southeastern United States. A complex of flies in the family Phoridae is known to uniquely control *Solenopsis* spp. in their native South America (Porter, 1998). These phorid flies, sometimes referred to as decapitating flies, lay individual eggs into worker ants while they forage or defend their mounds. The fly larva feeds and develops within the ant's head, killing the host in the process and causing the head to detach (Porter et al., 1995). When phorid flies are present, ants are preoccupied with defense, and decrease foraging to avoid the intensely annoying flies. Less foraging activity results in fewer ants and smaller and/or fewer mounds, allowing native ants and other insects to better compete for resources (Mehdiabadi et al., 2004).

Releases. Since 2000, we have released four species of phorid flies in twelve counties of North Carolina (see Table 1). Fly species were chosen for release at each locality based on the prevalent ant colony phenology, as follows: *Pseudacteon tricuspidis* and *P. obtusus* flies typically attack the larger workers found in monogyne (single-queen) colonies, whereas *P. curvatus* and *P. cultellatus* prefer smaller workers common to polygyne (multi-queen) colonies (Morrison et al. 1997).

Table 1: Phorid Release Data for North Carolina

Release Site (County)	GPS Coordinates	<i>Pseudacteon</i> species	Year	Number (est.)
Beaufort	35.660, -77.147	<i>P. tricuspidis</i>	2000	3000
Duplin	34.990, -78.132	<i>P. tricuspidis</i>	2002	2973
Robeson	34.623, -79.009	<i>P. tricuspidis</i>	2003	3849
Wayne	35.398, -78.030	<i>P. tricuspidis</i>	2004	4962
Wake	35.789, -78.373	<i>P. curvatus</i>	2005	13,708
Pitt	35.70, -77.50	<i>P. tricuspidis</i>	2006	3639
Scotland	34.853, -79.540	<i>P. tricuspidis</i>	2007	5206
Scotland	34.853, -79.540	<i>P. curvatus</i>	2007	13,008
Wayne	35.398, -78.030	<i>P. curvatus</i>	2008	12,000
Gaston	35.181, -81.109	<i>P. curvatus</i>	2009	11,000
Pitt	35.632, -77.332	<i>P. curvatus</i>	2010	12,000
Pitt	35.632, -77.333	<i>P. obtusus</i>	2010	1100
Randolph	35.63, -79.76	<i>P. curvatus</i>	2011	4914
Randolph	35.63, -79.76	<i>P. obtusus</i>	2011	2984
Franklin	36.071, -78.5406	<i>P. curvatus</i>	2012	9312
Franklin	36.071, -78.5406	<i>P. obtusus</i>	2012	2417
Wake	35.762, -78.680	<i>P. cultellatus</i>	2013	6096
Wake	36.006, -78.520	<i>P. curvatus</i>	2013	2592
Wake	36.006, -78.520	<i>P. obtusus</i>	2013	1404
Johnston	35.515, -78.431	<i>P. obtusus</i>	2014	5077
Johnston	35.515, -78.431	<i>P. cultellatus</i>	2014	4128
Anson	34.813, -80.253	<i>P. obtusus</i>	2015	1364
Anson	34.813, -80.253	<i>P. cultellatus</i>	2015	9408
Wake	35.7893, -78.7513	<i>P. obtusus</i>	2017	130
Wake	35.762, -78.680	<i>P. obtusus</i>	2017	390
Wake	36.006, -78.520	<i>P. obtusus</i>	2017	630

Surveys: A modified version of sticky traps developed by Puckett et al. (2007) has been used to monitor phorid flies after their release. Each trap consists of a plastic tri-stand (used by pizza delivery companies) glued to a 60 x 15 mm plastic petri dish. The tri-stand and sides of the petri dish are coated with Fluon™ to prevent fire ants from escaping or climbing the tri-stand. An inverted tri-stand is anchored to the original tri-stand with Velcro, and the legs of the inverted stand are coated with

Tanglefoot®. Traps are placed alongside fire ant mounds and baited with bits of Vienna sausages to attract ants, and therefore, phorids. Flies become ensnared in the Tanglefoot® when they alight to rest on the upright legs. The traps are collected within 24 hours of placement, so as to sample flies that are active at different times of day.

Surveys are conducted annually for 2-3 years after each release, so the most recent previous surveys were conducted in 2015. Additional releases were conducted this year, and surveys were resumed. Phorid fly releases since the inception of this program are presented in Table 1. Survey results confirm that *Pseudacteon curvatus* has established and spread reliably from sites of introduction in North Carolina. In 2009 and 2010, *P. curvatus* was collected from the following counties, in sites adjacent to counties where the flies had been released previously: Anson, Beaufort, Bladen, Brunswick, Chatham, Columbus, Cumberland, Durham, Edgecombe, Franklin, Granville, Guilford, Halifax, Harnett, Johnston, Lee, Martin, Montgomery, Moore, Nash, New Hanover, Onslow, Orange, Pender, Pitt, Richmond, Robeson, Sampson, Stanley, Union, and Wilson. Long-term establishment of the other species has not been confirmed (Table 2).

Project Summary. Phorid flies released for biological control have become established across the state. Of the four species released, current monitoring techniques have allowed for the sustained recovery of a single species, *Pseudacteon curvatus*. At this time, we cannot determine definitively whether this finding is an artifact of the trapping technique, or whether the prevailing species either outcompetes or is better adapted to this northernmost latitude of phorid fly release. Future surveys might be carried out to clarify this result.

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Acknowledgements

Phorid flies for release were kindly supplied by the rearing labs of USDA ARS CMAVE and the Florida Department of Agriculture and Consumer Services, Division of Plant industry, Gainesville, Florida. Paul Adams, Andrew Allen, Adolphus Leonard, Mike Massey, Nancy Oderkirk and Michelle Shooter worked on the field surveys.

Table 2: Phorid Survey Data for North Carolina

County	2017 GPS Coordinates	Location	<i>Pseudacteon</i> species	Year	Number (estimated)	Survey Date	Species established	Site Description
Anson	34.813, -80.253	White Rock Farm Morven 28119	<i>P. obtusus</i>	2015	1364	Sept. 2017	<i>P. curvatus</i>	pasture at side of road @ NC-SC border, David Gordon Rd
Anson	34.813, -80.253	White Rock Farm Morven 28119	<i>P. cultellatus</i>	2015	9408	Sept. 2017	"	" "
Beaufort	35.660, -77.147	10000 Cherry Run Rd, Washington, 27889 *site demolished 2016	<i>P. tricuspis</i>	2000	3000	< 2009	--	Fallow land, previously Voice of America towers
Duplin	34.990, -78.132	Warsaw Rest Stop, I40 & Hwy24	<i>P. tricuspis</i>	2002	2973	< 2009	--	Rest area
Franklin	36.071, -78.541	7412-7458 NC-96 Franklinton, NC 27525	<i>P. curvatus</i>	2012	9312	Sept. 2017	<i>P. curvatus</i>	Hwy 96 from Tom Linum Rd to Pebble Creek Drive
Franklin	36.071, -78.541	7412-7458 NC-96 Franklinton, NC 27525	<i>P. obtusus</i>	2012	2417	Sept. 2017	"	Hwy 96 from Tom Linum Rd to Pebble Creek Drive
Gaston	35.181, -81.109	Farm on Union New Hope Rd Gastonia	<i>P. curvatus</i>	2009	11,000	2009	<i>P. curvatus</i>	pasture near 275 Union New Hope Rd
Johnston	35.515, -78.431	Johnston Co. Landfill Smithfield 27577	<i>P. obtusus</i>	2014	5077	Oct. 2017	<i>P. curvatus</i>	grassy areas along road, closed landfill
Johnston	35.515, -78.431	Johnston Co. Landfill Smithfield 27577	<i>P. cultellatus</i>	2014	4128	Oct. 2017	"	grassy areas along road, closed landfill

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Pitt	35.70, - 77.50	Private property Hwy 43N Falkland, NC	<i>P. tricuspis</i>	2006	3639	Sept. 2017	<i>P. curvatus</i>	Pasture
Pitt	35.632, - 77.332	Pitt Co Fairgrounds Greenville, NC 27834	<i>P. curvatus</i>	2010	12,000	Sept. 2017	<i>P. curvatus</i>	Pitt County Fairgrounds
Pitt	35.632, - 77.333	Pitt Co Fairgrounds Greenville, NC 27834	<i>P. obtusus</i>	2010	1100	Sept. 2017	"	Pitt County Fairgrounds
Randolph	35.63, - 79.76	NC Zoo Asheboro, 27205	<i>P. curvatus</i>	2011	4914	Sept. 2017	<i>P. curvatus</i>	Zoo garden and entrance to parking area
Randolph	35.63, - 79.76	NC Zoo Asheboro, 27205	<i>P. obtusus</i>	2011	2984	Sept. 2017	"	Zoo garden and entrance to parking area
Robeson	34.623, - 79.009	Lumberton Farmers Market Lumberton 28358	<i>P. tricuspis</i>	2003	3849	< 2009	--	fallow land

Table 2: Phorid Survey Data for North Carolina, cont'd

County	2017 GPS Coordinates	Location	<i>Pseudacteon</i> species	Year	Number (estimated)	Survey Date	Species established	Site Description
Scotland	34.853, - 79.540	Twin Lakes Kennel Laurinburg 28352	<i>P. tricuspis</i>	2007	5206	< 2009	--	Grassy Field
Scotland	34.853, - 79.540	Twin Lakes Kennel Laurinburg 28352	<i>P. curvatus</i>	2007	13,008	< 2009	<i>P. curvatus</i>	Grassy Field
Wake	35.789, - 78.373	NCDA Beneficial Insects Lab Cary 27511	<i>P. curvatus</i>	2005	13,708	Sept. 2017	<i>P. curvatus</i>	naturalized area
Wake	35.789, - 78.751	NCDA Beneficial Insects Lab Cary 27511	<i>P. obtusus</i>	2017	130	Sept. 2017	"	raised garden beds

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Wake	35.762, - 78.680	NCSU Alumni Ctr Raleigh, NC 27606	<i>P. cultellatus</i>	2013	6096	Sept. 2017	<i>P. curvatus</i>	green spaces in and around parking lot
Wake	35.762, - 78.680	NCSU Alumni Ctr Raleigh, NC 27606	<i>P. obtusus</i>	2017	390	Sept. 2017	"	green spaces in and around parking lot
Wake	36.006, - 78.520	Harris Teeter Wake Forest 27587	<i>P. curvatus</i>	2013	2592	Sept. 2017	<i>P. curvatus</i>	large field between hwy and shopping center
Wake	36.006, - 78.520	Harris Teeter Wake Forest 27587	<i>P. obtusus</i>	2013	1404	Sept. 2017	"	large field between hwy and shopping center
Wake	36.006, - 78.520	Harris Teeter Wake Forest 27587	<i>P. obtusus</i>	2017	630	Sept. 2017	"	large field between hwy and shopping center
Wayne	35.379, - 78.047	Cherry Research Farm Goldsboro 27530	<i>P. tricuspis</i>	2004	4962	< 2009	--	CEFS Small Farm Unit
Wayne	35.397, - 78.033	Cherry Research Farm Goldsboro 27530	<i>P. curvatus</i>	2008	12,000	< 2009	<i>P. curvatus</i>	along road into CEFS Dairy Unit off Old Smithfield Rd

Emerald Ash Borer Overwintering in North Carolina 2017

On 28 February 2017 a total of five green ash trees infested with emerald ash borer (*Agrilus planipennis* = EAB) were selected and felled to quantify the overwintering stages of this pest in North Carolina. Participants were Wayne Langston, Kelly Oten, Rob Trickel (NCFS-Forest Health), Rob Montague (NCFS-Granville Co. Ranger), Christine Nalepa, and Steven Turner (NCDA & CS Beneficial Insects Laboratory). The trees were from two sites in Granville county: the Rob Montague property, north of Stovall (36.463046, -78.566499) and a roadside location in Butner (36.15290, -78.767530). Two trees were felled in the former site (Trees A and B) and three in the latter (Trees C, D, and E). The bole of each tree was sawed into manageable sections that were labelled sequentially from the base to the top. These were transported to NCDA Support Operations property, where the logs were debarked and inspected for life stages of EAB. The debarking of 51 logs was carried out 1-14 March (Fig.1, left). Larvae that were present were measured with a mm scale; life stages not damaged during collection were preserved in alcohol.



Fig. 1. Left, debarked ash logs; right, EAB pupa in overwintering chamber.

Results: A total of 59 EAB life stages were recovered from overwintering chambers in the logs (Table 1): 50 pupae (Fig. 1, right) and 9 larvae. Larvae were recovered from both sampled sites; their lengths are given in Table 2. When compared to larval lengths given in Chamorro et al. (2012), it is apparent that most were third instars, although those at the extreme end of the size range may be an adjacent instar. No J-larvae (pre-pupae curled in chamber) were found. Possible parasitoids (n=3) were collected from EAB overwintering chambers from Tree D (Butner site) and were submitted to Matt Bertone (North Carolina State University) for identification. He determined that it was a native parasitoid wasp, and the finding resulted in the following publication in a professional journal:

Bertone, M.A., C.A. Nalepa, K. Oten and S. Turner. 2017. Record of the hymenopteran parasitoid *Xorides (Exomus) humeralis* (Ichneumonidae: Xoridinae) from emerald ash borer galleries (Coleoptera: Buprestidae) in North Carolina. *Proceedings of the Entomological Society of Washington* 119 (3):514-517.

Table 1. Life stages of EAB found in trees sampled from Granville Co., NC on 28 Feb 2017.

Site	Tree	No. of logs	EAB larvae	EAB pupae	EAB total
Stovall	A	7	0	0	0
Stovall	B	2	5	4	9
Butner	C	19	3	9	12
Butner	D	12	1	33	34
Butner	E	11	0	4	4
TOTALS		51	9	50	59

Table 2. Length of EAB larvae in trees sampled from Granville Co., NC on 28 Feb 2017. Instars based on lengths given in Chamorro et al. (2012): instar III 16-26mm; instar IV/prepupa 27-35mm.

Site	Tree	No. of larvae	Length of larvae (mm)	Probable instars
Stovall	A	0	-	-
Stovall	B	5	14, 19, 19, 19, 22	5-III
Butner	C	3	14, 15, 24	3-III
Butner	D	1	26	1-III or IV/pre-pupa
Butner	E	0	-	-

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Reference

Chamorro, M.L., M.G. Volkovitsh, T.M. Poland, R.A. Haack, and S.W. Lingafelter (2012). Preimaginal Stages of the Emerald Ash Borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae): An Invasive Pest on Ash Trees (*Fraxinus*). 2012. PloS One doi:10.1371/journal.pone.0033185.g014

The Cooperative Agricultural Pest Survey (CAPS) Program

The CAPS program is a national, early warning pest detection network, funded through a cooperative agreement with USDA-APHIS-PPQ for domestic surveillance of exotic plant pests. Such pests hold economic, agricultural and/or environmental importance to North Carolina (NC) and the U.S. and typically include plant pests that are not known to occur domestically. These surveys help safeguard our nation's agriculture and natural resources through early detection, especially for those pests that pass through front-line inspections at our ports of entry. Surveys also concentrate on pests of export significance which are of concern to our trading partners. The CAPS program follows guidelines to ensure that data, on a continuing basis, is scientifically valid, current and reliable. The state CAPS advisory committee helps drive and focus surveys for each state. Its core members include the State Plant Health Director (SPHD), State Plant Regulatory Official (SPRO), Pest Survey Specialist (PSS) and the State Survey Coordinator (SSC). Other members may be invited to provide guidance in their area of expertise. National and/or State level surveys concentrate on three main areas of importance; entomological, pathological or exotic weed species. All data collected from these surveys are entered into the National Agricultural Pest Information System (NAPIS) before December 1st for inclusion into the Nation Plant Board's annual report.

Executive Summary

The 2017 North Carolina CAPS program was successful in procuring funding for CAPS and Farm Bill surveys. Seven independent surveys for exotic plant pests were conducted throughout the state, covering 49 counties. Such surveys included; mollusk, forest pests, oak commodity, grape commodity, Asian defoliators, a phytophthoras state specific survey and solanaceous commodity. A total of thirty-eight different exotic plant pests were surveyed from April through the end of October, with survey timing being unique for each pest. All surveys were completed following the 2017 CAPS guidelines, so that negative data were reportable. **There were no positive detections for any of the targeted plant pests during the 2017 survey season.**

The NC CAPS advisory committee held its annual meeting on May 23rd, 2017. The meeting focused on planning survey objectives for the upcoming 2018 season. Survey priorities for 2018 were determined and survey plans were made to minimize overlap across survey programs. New survey proposals were submitted through CAPS and Farm Bill section 10007 outlining the advisory committee's suggestions. All proposals have been funded for 2017 surveys.

CAPS Surveys

Three CAPS surveys were selected for the 2017 season in North Carolina; mollusk, forest pests and oak (Figure 1).

Mollusk Survey

The mollusk survey was completed in June and July at seven locations; Port of Wilmington (New Hanover County), Sunny Point (Brunswick County) and five tile importers as well as rail road tracks near industrial complexes (Wake County). Eight exotic species of mollusk were surveyed; giant African snail (*Lissachatina fulica*), Hygromiid snails (*Cernuella spp.*) and Leatherleaf slug spp. (*Veronicella spp.*, *Belocaulus spp.*, *Celosias spp.*, *Laevicaulis spp.*, *Sarasinula spp.*, and *Semperula spp.*). Both the Pest Survey Specialist (PSS) at PPQ and State Survey Coordinator (SSC) at NCDA&CS completed the surveys for the aforementioned locations. Several specimens were forwarded to identifiers with no actionable findings.

Oak Commodity Survey

North Carolina completed the 2017 oak commodity survey for the following exotics; Japanese oak wilt (*Raffaelea quercivora*), variegated golden tortrix moth (*Archips xylosteanus*), false codling moth (*Thaumatotibia leucotreta*), oak processionary moth (*Thaumetopoea processionea*), green oak tortrix moth (*Tortrix viridana*) and oak ambrosia beetle (*Platypus quercivorus*). Trapping for this survey began in May and ended in September. Monthly visits were conducted at thirty-six locations for lure replacement, sticky card collection or trap replacement (Table 1). Bi-weekly visits for the oak ambrosia beetle multi-funnel trap were accomplished to limit the decomposition rate of beetle specimens.

Table 1. Total number of trapping locations by county for the 2017 oak commodity survey.

County	No. Locations		County	No. Locations
Alamance	1		Johnston	2
Alleghany	1		Macon	1
Buncombe	1		Madison	1
Burke	1		New Hanover	2
Clay	1		Rockingham	2
Columbus	2		Rutherford	1
Davie	1		Stokes	1
Forsyth	2		Surry	3
Guilford	1		Swain	1
Harnett	2		Transylvania	1
Haywood	2		Wayne	2
Iredell	3		Wilkes	1
Total locations				36

Forest Pests Survey

The Forest Pest survey was completed during June and July throughout the state concentrating on three pests; oak splendor beetle (*Agrilus biguttatus*), Goldspotted oak borer (*Agrilus auroguttatus*) and Asian Longhorned beetle (*Anoplophora glabripennis*). Both *Agrilus* species were surveyed by utilizing the cercheris wasp at ballfields throughout the state. The Asian Longhorned beetle was surveyed utilizing declining maple near industrial parks.

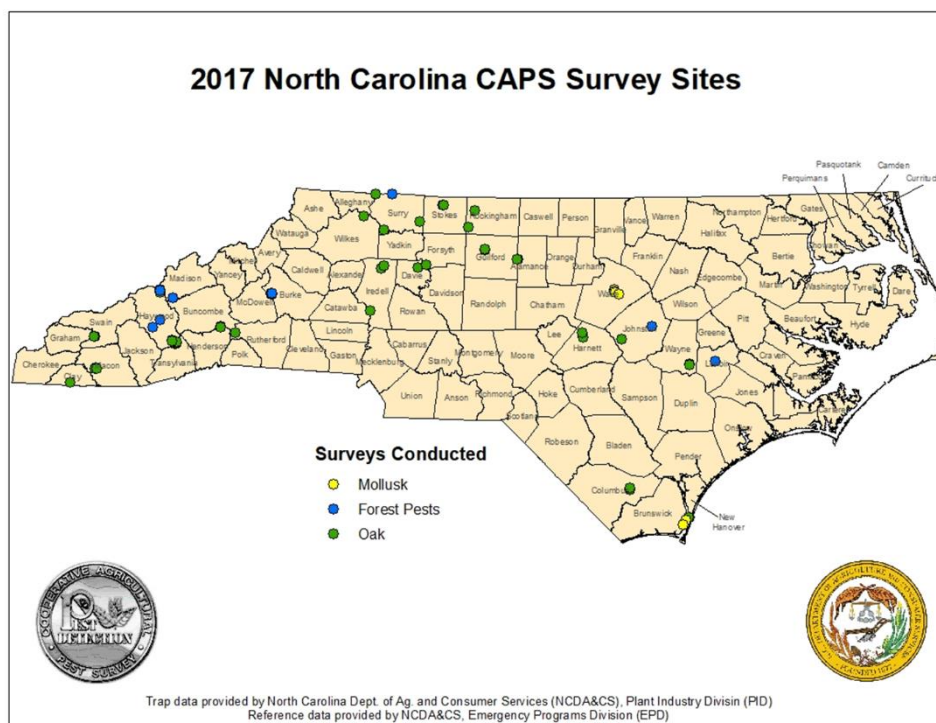


Figure 1. 2017 CAPS survey sites for Oak commodity, Forest Pests and Mollusk in North Carolina

Farm Bill Surveys

Every year, the SSC applies for Federal assistance for the state to conduct exotic plant pest surveys. In 2017, money for four Farm Bill surveys were awarded to NC; Asian defoliators, grape commodity, solanaceous commodity and a *Phytophthora spp.* survey.

Asian Defoliators

Nine exotic plant pests were surveyed under Asian defoliators; Asian Gypsy Moth (*Lymantria dispar asiatica*), Okinawa gypsy moth (*L. albescens*), Japanese gypsy moth (*L. dispar japonica*), Hokkaido gypsy moth (*L. umbrosa*), Rosy Moth (*L. Mathura*), Nun Moth (*L. monacha*), Pine Tree Lappet (*Dendrolimus pini*), Masson Pine Moth (*D. punctatus*) and Siberian Silk Moth (*D. sibiricus*). Locations included ports of entry and military installations. An introduction of any of these exotics would have serious implications for North Carolina forests. Host trees for these pests are considered economically important and include oak, pine, ash, elm, maple and walnut.

A total of 12 trapping locations were placed across the state over a four-month period from June to September (Figure 2). Monthly site visits were used to replace sticky cards and/or lures. Typical survey sites for this survey include military installations. It was previously determined that multiple survey locations exist on larger installations, and may include a combination of several forms of conveyance including deep water ports with rail yards, airstrips or a combination thereof. These are important pathways for this survey and are

prioritized accordingly. All samples were collected at the servicing of each trap and screened for the presence of target pests.

Grape Commodity

We surveyed for six exotic species; Christmas berry webworm (*Cryptoblabes gnidiella*), spotted lanternfly (*Lycorma delicatula*), light brown apple moth (*Epiphyas postvittana*), European grapevine moth (*Lobesia botrana*), Egyptian cottonworm (*Spodoptera littoralis*) and cotton cutworm (*Spodoptera litura*). The survey was completed at fourteen locations using plastic delta and bucket traps that were set in July and pulled in September (Figure 3). The spotted lanternfly was visually surveyed since there is no approved trap/lure combination for this pest.

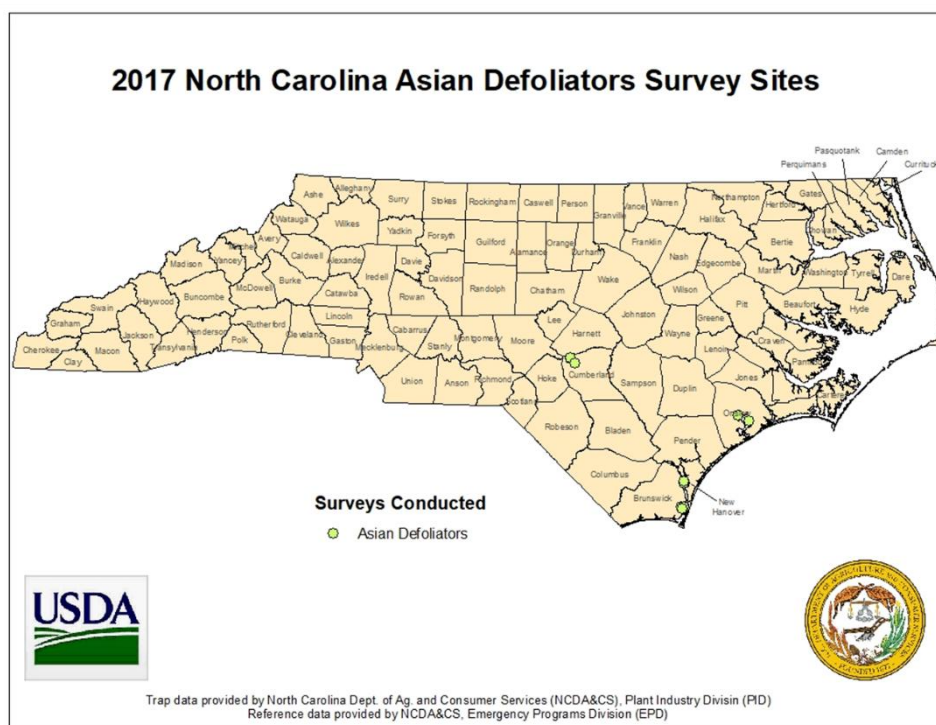


Figure 2. 2017 North Carolina survey sites for the Asian defoliators survey.

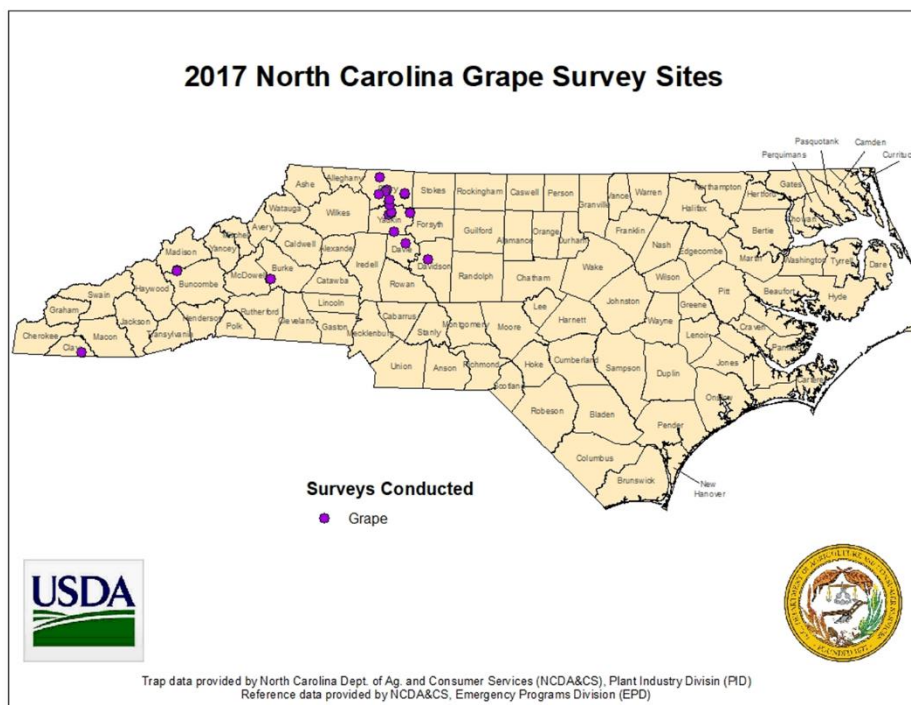


Figure 3. 2017 grape commodity survey locations for North Carolina.

Solanaceous Commodity

Four exotic plant pests of the solanaceous commodity were surveyed; tomato leaf miner (*Tuta absoluta*), old world bollworm (*Helicoverpa armigera*), Tomato fruit borer (*Neoleucinodes elegantalis*) and golden twin spot moth (*Chrysodeixis chalcites*). All are regarded as being highly destructive pests of solanaceous crops and pose a significant threat to North Carolina agriculture as the state has host material and climate conducive to supporting these exotics. We surveyed thirty-eight host sites that included commercial tomato, tobacco and pepper production fields (Figures 4 and 5).

Helicoverpa armigera is found in parts of Africa, Asia, Europe, Middle East and Oceania. In early 2013, in the state of Mato Grosso, Brazil, both larvae and moths were collected from infested *Bacillus thuringiensis* (Bt) cotton fields, and were later confirmed through molecular characterization as being *H. armigera*. Old world bollworm was recently detected in Puerto Rico in September of 2014 and most recently in Florida in 2015 as an isolated incident. This pest is known for quickly developing levels of resistance to commonly used insecticides, including resistance to transgenic crops using Bt. Capable of long distance migration, it may adapt to environmental conditions if it becomes too warm or dry. Economically, it is one of the costlier pests and reports of serious losses up to 100% are common in infested areas. Early detection and identification of this pest will limit spread to the natural environment and aid in eradication.



Figure 4. A tomato field that was surveyed during 2017.

Samples were collected from all traps and were later screened for the presence of target pests during the month of October by the SSC with assistance from a taxonomic expert hired to help with this project. The taxonomic expert performed all necessary dissections to rule out positive identifications for *Helicoverpa armigera*. Dissections were completed on 297 suspect individuals with no positive determinations.

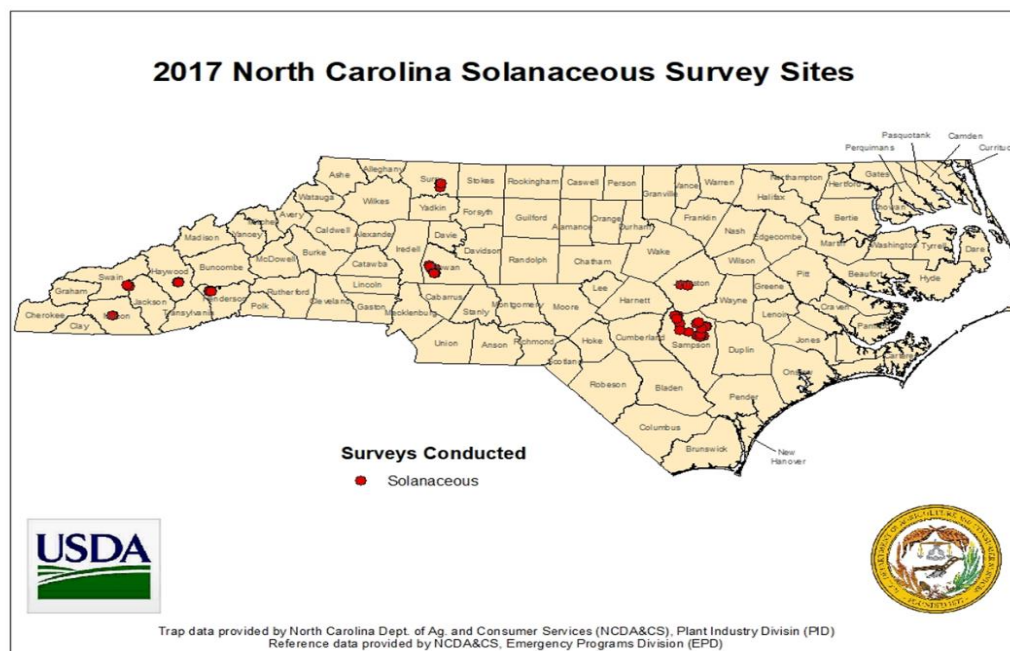


Figure 5. 2017 solanaceous commodity survey locations for North Carolina.

Phytophthora spp.

North Carolina conducted a *Phytophthora ramorum* and *P. kernoviae* survey during 2017. Both pathogens pose a significant threat to NC forests and nurseries. *Phytophthora kernoviae*, also known as phytophthora leaf blight, is not known to occur in the U.S., but does infect important plant species including; *Quercus*, *Magnolia*, *Rhododendron* and *Pieris*. *Phytophthora ramorum*, also known as sudden oak death, has been present along parts of the Pacific Northwest since the mid-1990s and is found intermittently in Southeastern states, including NC. The primary pathway for these pathogens is from trade of infected ornamental plants and since both pathogens share common hosts and affect stem and leaf tissue, a survey was developed to include both pathogens for improved efficiency. This survey was developed with Leah Roberts, Regulatory Plant Pathologist at NCDA&CS. While this survey is still ongoing, to date more than 50 sites have been surveyed from nurseries and natural settings (Figure 5). All suspect samples were screened for the presence of *Phytophthora spp.* using Enzyme Linked Immunosorbent Assay (ELISA) with positive samples forwarded to Kansas State University-Manhattan Diagnostic Laboratory for further diagnostics. To date, all positive samples have tested negative for our targets.

A gap in our knowledge and understanding of which *Phytophthora spp.* currently infect NC nurseries and natural environs exists and we look to close this gap in future farm bill funding. Identification of such species as it relates to location and plant material being infected will aid in discerning high risk areas for these important plant pathogens and present an opportunity in potentially describing rare, unknown or not known to occur in NC plant pathogenic *Phytophthora spp.*

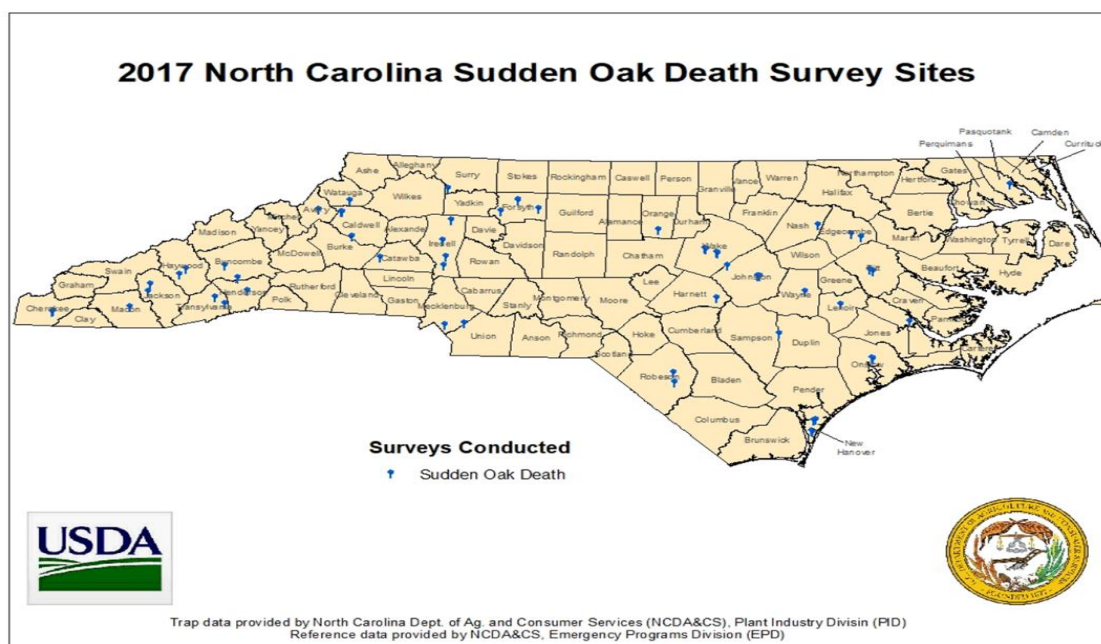


Figure 5. 2017 *Phytophthora spp.* survey locations for North Carolina.

2017 Additional Survey/Outreach Work

While this past survey season was quiet for the aforementioned pests, it still held excitement on other fronts. In February, an extermination company sent unidentified longhorned beetle specimens to North Carolina State University's Plant Disease and Insect Clinic (PDIC). The beetle was identified as *Plagionotus christophi* (Figure 6). A warehouse in Mecklenburg County holding wooden crafts originating from China was inspected by USDA and NCDA&CS. Several additional dead beetles were observed on the floor however no beetles were found inside boxes or packing material. Insect traps were hung by USDA and stayed in place throughout the year with no further specimens discovered.



Figure 6. *Plagionotus christophi* found as interception in Mecklenburg County. Photo by Matt Bertone, PDIC.

In March, a homeowner in Rowan County contacted their extension agent about a beetle emerging from a wooden dresser that was purchased from a local art supply store. The specimen



was forwarded to Matt Bertone at PDIC who contacted NCDA&CS (Figure 7). The beetle was identified as China fir borer (*Semanotus sinoauster*). This interception resulted in a limited recall from store locations carrying the specific SKU numbered item.

Figure 7. *Semanotus sinoauster*, intercepted by a homeowner in Rowan County in a wooden dresser purchased from an arts and crafts supply shop. Photo by Matt Bertone, PDIC.

In late July, prickly pear cactus moth (*Cactoblastis cactorum*) was observed by a homeowner in Southport, Brunswick County. Whitney Swink, NCDA&CS Regulatory Entomologist and the CAPS Coordinator visited the site and returned with specimens (Figure 8).



Figure 8. A) *Cactoblastis cactorum* egg stick can be seen as circled mimicking a prickly pear cactus spine. (Whitney Swink, NCDA&CS). B) Larvae feeding on prickly pear cactus. (Peggy Greb, USDA). C) Feeding damage with plant sap exudate. (Jarred Driscoll, NCDA&CS).

A USDA research entomologist reached out to us and was kind enough to provide information as well as lure and traps. Traps were placed in Southport, Oak Island, Caswell Beach and Surf City. While no further specimens were collected, this may represent the natural northern progression of this pest as it is present from Gulf states on up to its last detection in Charleston, SC in 2006. This is only a pest of prickly pear (*Opuntia spp.*). Prior to the financial crisis of the late 2000's, prickly pear cactus moth was part of a federal survey program. Since this time however, states have stopped surveying for this pest and may be considered present in coastal communities along the southeast where *Opuntia spp.* are present.

In September, a company self-reported bark beetles emerging from wood crates originating from India (Figure 9). Matt Bertone at PDIC identified them as several different exotic species (Figures 9 and 10); bostrichid beetle (*Sinoxylon anale*), lesser auger beetle (*Heterobostrychus aequalis*) and bostrichid beetle (*Sinoxylon conigerum*). It was confirmed with USDA that none of the exotics identified would survive our temperate region and no further action was taken.



Figure 9. Warehouse infested with bark beetles in wooden crates originating from India.



Figure 10. A powder post beetle, *Sinoxylon conigerum*, emerged from wooden crates originating from India.

Lastly, there are several exotic plant pests currently infesting areas within the US and pose an elevated risk to North Carolina. This risk is elevated because of their proximity to our state, suitable hosts and environment and/or pathways to bring them over state borders. These plant pests are, sudden oak death (*Phytophthora ramorum*), Asian longhorned beetle (*Anoplophora glabripennis*), Asian gypsy moth (*Lymantria dispar asiatica*) and spotted lanternfly (*Lycorma delicatula*). The North Carolina CAPS program, in cooperation with other individuals, programs and departments, has been actively surveying for these pests at high risk areas throughout the state, and will continue conducting such surveys in addition to all the other commodity-based surveys it oversees.

Entomological Programs Annual Report

The following report summarizes the primary activities and accomplishments of the NCDA&CS Entomological Programs in 2017.

SWEETPOTATO WEEVIL PROGRAM

North Carolina's sweet potato production continues to increase as demand for sweet potatoes increases in the national and international markets. The success of the sweet potato industry in NC is attributed to several factors including an efficient marketing strategy and strong research programs at state universities aimed at developing new and better varieties of sweet potatoes. Additionally, at NCDA&CS Plant Industry Division, we manage an intensive regulatory program intended to keep the sweetpotato weevil (*Cylas formicarius*; SPW), the most important pest of sweet potatoes in the world, out of production areas in NC. SPW is a pest of regulatory concern that can significantly affect the NC sweet potato industry by 1) reducing yields in affected fields, 2) damaging the quality of infested sweet potatoes, 3) increasing the production cost for farmers, and 4) imposing restrictions to the movement of sweet potato from affected to non-affected areas in NC and outside of NC.

Our mission at NCDA&CS Plant Industry Division is to implement effective plant pest programs to reduce the risk of accidental introductions of SPWs into NC sweet potato production areas and to mitigate and eradicate weevil populations that might have been introduced to the state in order to protect the NC sweet potato industry. Early detection and rapid response (EDRR) of weevil detections is instrumental for a successful eradication program. Our most important tool for EDRR is surveys. Every year, surveys are conducted throughout the state using traps baited with lures containing a female-produced pheromone that attracts male sweetpotato weevils. These traps are deployed in production fields, regulatory sites including but not limited to storage, processing and packing facilities, micropropagation greenhouses, and/or any other sites where regulated articles for sweetpotato weevil are found. Traps are also deployed in the NC sweetpotato weevil quarantine area in New Hanover and Brunswick counties to monitor potential movement of sweetpotato weevils into the production areas and to conduct research.

Field Surveys

Field surveys were conducted from mid-August through September 2017 in 51 counties, primarily in eastern North Carolina. 12,153 traps were set in 10,422 fields in approximately 86,336 reported acres (Table 1). Trap set was done following the established guidelines and protocols developed by the Southern Plant Board (SPB) in 1995. Traps were deployed at a minimum of one trap per 10 acres with a minimum of two traps per field (exceptions were made

if a field was under two acres). Conventional green boll weevil traps were used because of their low cost (Figure 1a). Traps were deployed at an average density of one trap for every 5.25 acres and left in the field for an average of 24 days. These values are in accordance with the established SPB sweetpotato weevil survey guidelines. Custom-made georeferenced pdf maps were used in mobile devices (iPad minis) to navigate and locate sweet potato fields and to collect data including time and date of trap set, field type (reported, unreported, and absent), and coordinates (latitude and longitude) for each trap set. Data collected during the trap pull process include the trap condition (lost, damaged, good) and the number of weevils found. **No weevils were found in field surveys during this period in 2017.**

TABLE 1. SUMMARY OF THE SWEETPOTATO WEEVIL FIELD TRAPPING (2017)

County	Reported Acres	Mapped Fields	Traps Set	Acres per Trap	Mean no. of days in the field
Beaufort	61.96	7	10	6.20	30
Bertie	1066.27	120	132	8.08	19
Bladen	290.91	26	46	6.32	22
Brunswick	8.00	1	3	2.67	26
Camden	2.80	2	2	1.40	22
Carteret	5.40	3	6	0.90	21
Chowan	233.36	28	56	4.17	22
Clay	0.62	1	1	0.62	23
Columbus	1785.34	224	230	7.76	20
Craven	107.30	21	20	5.37	20
Cumberland	725.10	75	112	6.47	21
Davidson	0.90	1	1	0.90	22
Duplin	3298.13	309	464	7.11	22
Edgecombe	8263.43	874	1095	7.55	22
Forsyth	50.50	13	14	3.61	30
Franklin	80.83	19	22	3.67	25
Granville	134.27	46	23	5.84	25
Greene	6162.40	584	785	7.85	23
Guilford	17.50	5	4	4.38	29
Halifax	944.49	135	154	6.13	22
Harnett	2571.49	388	340	7.56	32
Hertford	168.94	16	19	8.89	21
Johnston	10741.96	1539	1582	6.79	25
Jones	305.82	24	45	6.80	21
Lee	71.32	17	21	3.40	35
Lenoir	2392.11	201	313	7.64	20
Macon	0.12	1	1	0.12	23
Martin	372.60	33	40	9.32	29
Montgomery	25.80	5	5	5.16	21

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Moore	174.86	23	26	6.73	36
Nash	9470.45	1349	1514	6.26	24
Northampton	122.31	15	16	7.64	23
Onslow	170.60	24	40	4.27	18
Orange	6.50	5	3	2.17	22
Pamlico	117.59	15	25	4.70	20
Pasquotank	77.40	14	16	4.84	22
Person	294.00	47	47	6.26	31
Pitt	4464.64	464	558	8.00	20
Richmond	20.14	3	4	5.04	24
Robeson	824.97	38	61	13.52	21
Sampson	13328.08	1256	1861	7.16	23
Scotland	481.99	17	85	5.67	31
Stanly	0.18	1	1	0.18	24
Stokes	10.20	13	14	0.73	28
Tyrrell	6.00	2	4	1.50	24
Vance	0.40	1	1	0.40	25
Wake	710.92	127	123	5.78	19
Warren	41.65	11	5	8.33	25
Wayne	6952.13	746	917	7.58	24
Wilson	9167.95	1531	1283	7.15	23
Yadkin	3.08	2	3	1.03	27
Totals	86,335.71	10,422	12,153	5.25¹	24²

¹Average acres per trap

²Average number of days in the field across all counties

Regulatory Sites

Sweet potato regulatory sites include but are not limited to storage facilities, processing plants, micropropagation units and greenhouse operations growing ornamental sweet potatoes and were surveyed all year long. Because of the inter- and intra-state movement of sweet potatoes these regulatory sites are a high risk pathway for the introduction of sweetpotato weevil. Universal moth traps (or bucket traps) were used instead of the conventional green boll weevil traps in the field because of the higher trapping efficiency (Figure 1b). For these operations, a minimum of two traps (one inside and one outside) were set per structure containing sweet potatoes. Traps were placed in strategic locations where sweet potatoes are stored and/or in and around the locations outside the buildings where sweet potatoes are loaded or unloaded. Lures were changed in each trap once a month and data collection was done using the same procedure detailed for the field surveys. A total of 184 regulatory sites (totaling 3,917 inspections) were surveyed and **no weevils were found in storage facilities during the 2017 season.**

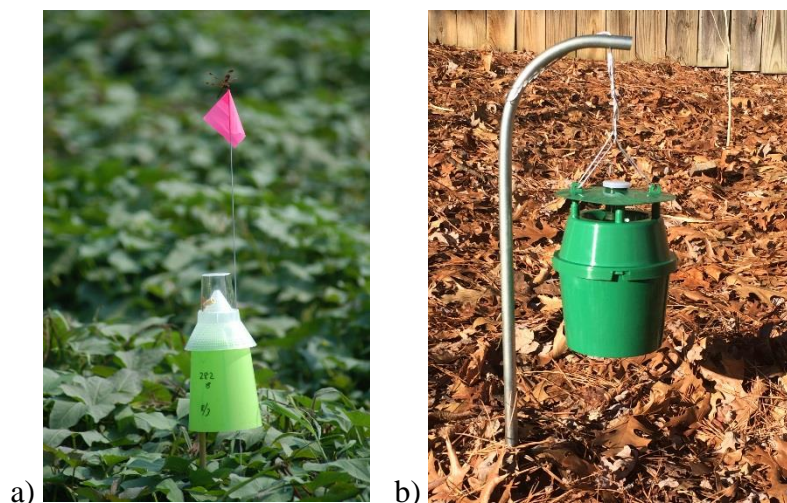


Figure 1. a) Green boll weevil trap baited with sweetpotato weevil lure used to survey sweet potato fields; b) bucket traps used to survey storage facilities and the North Carolina sweetpotato weevil quarantine area

Sweetpotato Weevil Eradication (Phase 1 - Completed)

NCDA&CS Plant Industry Division was awarded a Specialty Crop Block Grant (USDA Farm Bill 2014) to determine the spatial and temporal distribution of sweetpotato weevil populations in the quarantine area of North Carolina (portions of New Hanover and Brunswick Counties) with the eventual goal of eradicating the pest entirely from the state. The project began in 2015 with the setup of a detection grid consisting of 398 universal moth traps in a hexagonal grid pattern. Using the results of the 2015 detection grid a delimiting grid consisting of 325 traps was set up in January 2016 and traps were checked weekly from February through the end of the year (Figure 2). This work continued through June 2017 when Phase 1 of the project was concluded. From this information we improved our knowledge of where the weevil populations are clustered in the quarantined areas of New Hanover and Brunswick counties. The information collected during Phase 1 will be utilized in Phase 2—the eradication phase—which will begin early 2018.

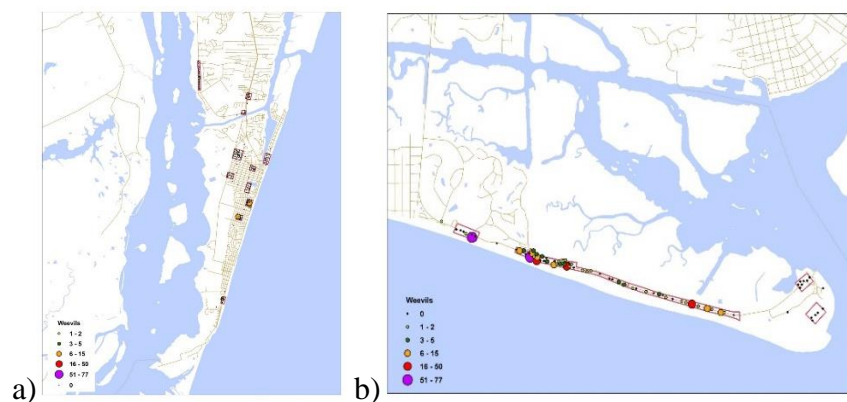


Figure 2. Delimiting grids for a) New Hanover County (Carolina and Kure Beaches) and b) Brunswick County (Caswell Beach)

GYPSY MOTH SLOW THE SPREAD AND ERADICATION PROGRAM

In 2017, NCDA&CS, in cooperation with USDA-APHIS-PPQ, USDA-Forest Service (USFS), and the Slow the Spread (STS) Foundation, carried out an extensive trapping, treatment, regulatory, and alternate life stage survey program aimed at detection and eradication of European gypsy moth (EGM), a major invasive pest of hardwood trees. The program in North Carolina is divided into two different areas, STS and Eradication, as shown in Figure 1.

Trapping

A total of 18,772 traps were set in 100 counties in NC from April to June 2017 and removed from July to September 2017. Traps were baited with disparlure, the female-produced sex pheromone of gypsy moth (2-methyl-7R, 8S-epoxy-octadecane). Trap locations and data were recorded on iPad units. 1628 adult gypsy moth males were captured in 881 positive traps in NC in 2017. Positive catches were entered into the gypsy moth trapping database at Virginia Tech. Final results of these surveys are shown in Table 1 and in Figure 2.

Male moth captures in 2017 were on par with expectations and significantly lower than last year, which was an unusually high catch year, though still with three distinct pockets of high captures along the Virginia-North Carolina border, probably due to pressure from mounting populations within the generally infested area to the north of those areas. 11 treatments and multiple delimiting grids are proposed for 2018 to follow up in high-capture locations.

Per 2017 USDA-APHIS-PPQ protocol as stipulated in the cooperative agreement (AP17PPQFO000C323), trapping surveys were conducted in the Eradication area (all non-STs area) as shown in Figure 1. Delta traps were set in an area-wide grid of 1 trap per 3 kilometers, with some areas being trapped at one trap per 500 or 1000 meters if there was a suspected EGM population. Funding provided by USDA-APHIS-PPQ was used to employ 12 temporary employees, buy the necessary survey supplies (including traps, lures, iPads, and office supplies), and for operational expenses (including fuel and maintenance for survey vehicles). Additionally, funding from USFS was used to hire two temporary employees who monitored traps close to areas treated in 2017 in the Eradication area, purchase supplies, and for operational expenses associated with this work.

In the STS area, seven contractors set traps in 31 bid units, according to site data provided by the STS Foundation in cooperation with Virginia Tech. Delta traps were set in an overall grid of 1 trap per 2 kilometers along the northern portion of the STS area; all other portions of the STS

area were trapped at a density of 1 trap per 3 kilometers. Locations with high catches the previous year or areas under evaluation from treatments in previous years were surveyed in a 500-meter or 1000-meter grid utilizing either high-density milk carton traps or delta traps.

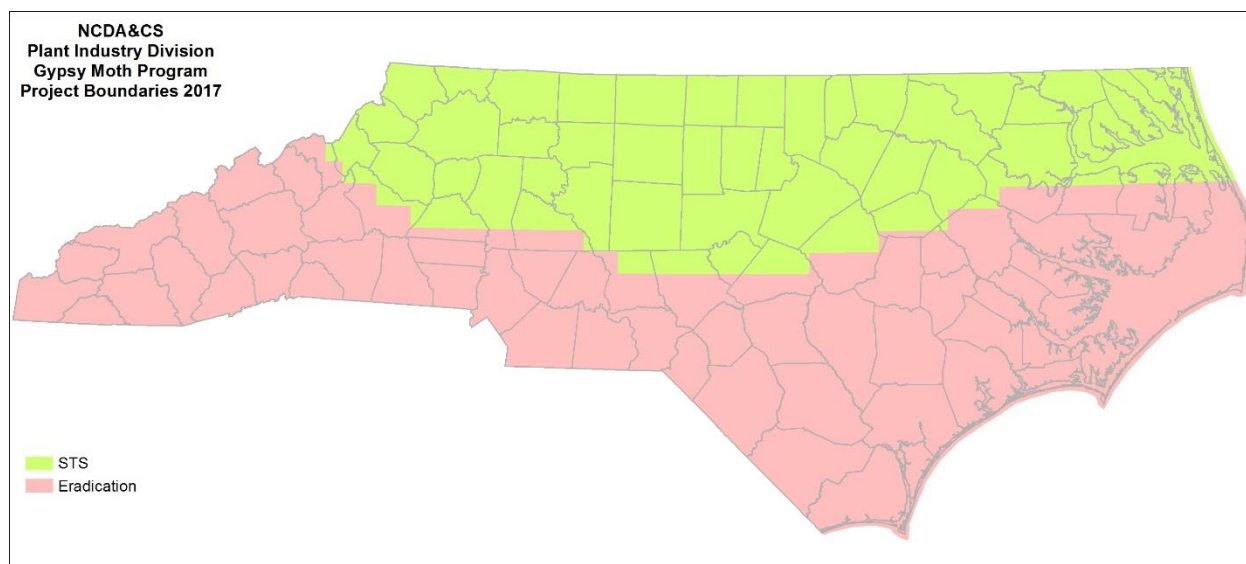


Figure 1. North Carolina Gypsy Moth Program Project Boundaries 2017.

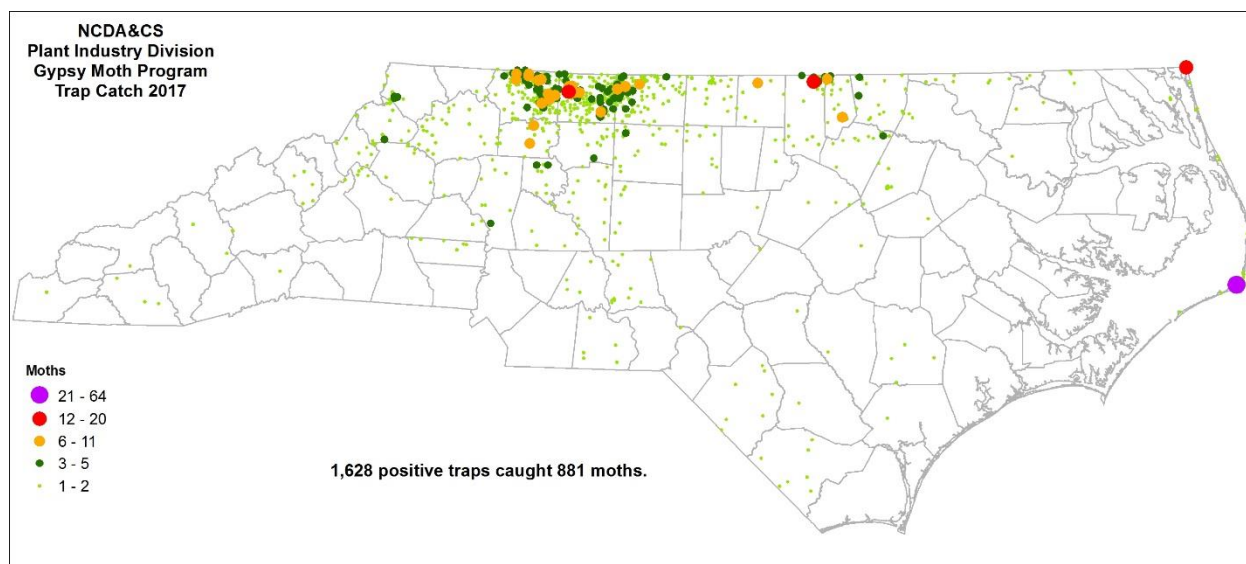


Figure 2. North Carolina gypsy moth trap catches in 2017.

Table 1. 2017 survey results in NC showing total number of traps placed per county, number of positive traps for EGM in each county, and the total number of moths in those positive traps.

County	Total Traps	Total Positive	Total Catch
Alamance	225	10	11
Alexander	78	2	2
Alleghany	218	2	3

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Anson	140	5	5
Ashe	394	13	23
Avery	72	7	8
Beaufort	233	0	0
Bertie	308	1	1
Bladen	248	1	1
Brunswick	246	0	0
Buncombe	168	0	0
Burke	141	5	5
Cabarrus	109	0	0
Caldwell	153	8	8
Camden	155	0	0
Carteret	124	0	0
Caswell	386	26	28
Catawba	114	2	2
Chatham	214	2	3
Cherokee	105	1	1
Chowan	88	0	0
Clay	34	0	0
Cleveland	138	0	0
Columbus	245	7	7
Craven	183	0	0
Cumberland	184	1	1
Currituck	232	7	26
Dare	446	28	197
Davidson	207	12	13
Davie	78	10	14
Duplin	228	4	4
Durham	119	2	2
Edgecombe	150	0	0
Forsyth	221	18	20
Franklin	244	10	16
Gaston	99	0	0
Gates	232	3	3
Graham	44	0	0
Granville	391	42	88
Greene	76	0	0
Guilford	314	16	20
Halifax	452	2	2

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Harnett	174	0	0
Haywood	112	3	4
Henderson	91	1	1
Hertford	228	4	4
Hoke	114	0	0
Hyde	151	1	2
Iredell	173	8	11
Jackson	113	0	0
Johnston	221	1	1
Jones	132	0	0
Lee	74	0	0
Lenoir	114	0	0
Lincoln	89	6	6
Macon	102	3	3
Madison	105	0	0
Martin	126	0	0
McDowell	103	0	0
Mecklenburg	173	0	0
Mitchell	49	1	1
Montgomery	162	11	12
Moore	189	0	0
Nash	221	8	8
New Hanover	77	0	0
Northampton	405	7	7
Onslow	167	0	0
Orange	178	0	0
Pamlico	101	0	0
Pasquotank	154	0	0
Pender	264	1	1
Perquimans	152	0	0
Person	331	6	17
Pitt	187	0	0
Polk	55	0	0
Randolph	240	5	6
Richmond	125	1	1
Robeson	260	7	9
Rockingham	564	126	201
Rowan	164	4	5
Rutherford	157	0	0

Sampson	273	1	1
Scotland	84	0	0
Stanly	123	4	4
Stokes	416	157	290
Surry	486	171	372
Swain	44	1	1
Transylvania	90	0	0
Tyrrell	88	0	0
Union	169	0	0
Vance	259	17	37
Wake	254	3	3
Warren	364	18	23
Washington	95	0	0
Watauga	194	11	16
Wayne	171	0	0
Wilkes	451	25	30
Wilson	111	1	1
Yadkin	189	16	31
Yancey	78	5	5
Total	18,772	881	1,628

Treatments

Six mating disruption treatments were conducted in North Carolina in 2017 totaling 14,657 acres, all in cooperation with the USDA-Forest Service in the STS area (Figure 3 and Table 2). Each site received one dose of SPLAT Gypsy Moth-Organic at a rate of 6 grams per acre. These sites will be trapped in 2018 and 2019 to determine the efficacy of the treatments. In the Eradication area one location – Buxton, in Dare County – was treated three times aurally with Gypchek (totaling 2,250 acres), a product that contains a gypsy moth-specific virus. One additional site in the Eradication area near Bolivia in Brunswick County was treated twice aurally with Btk (totaling 1,548 acres). All told, 18,455 acres were treated for gypsy moth in North Carolina in 2017.

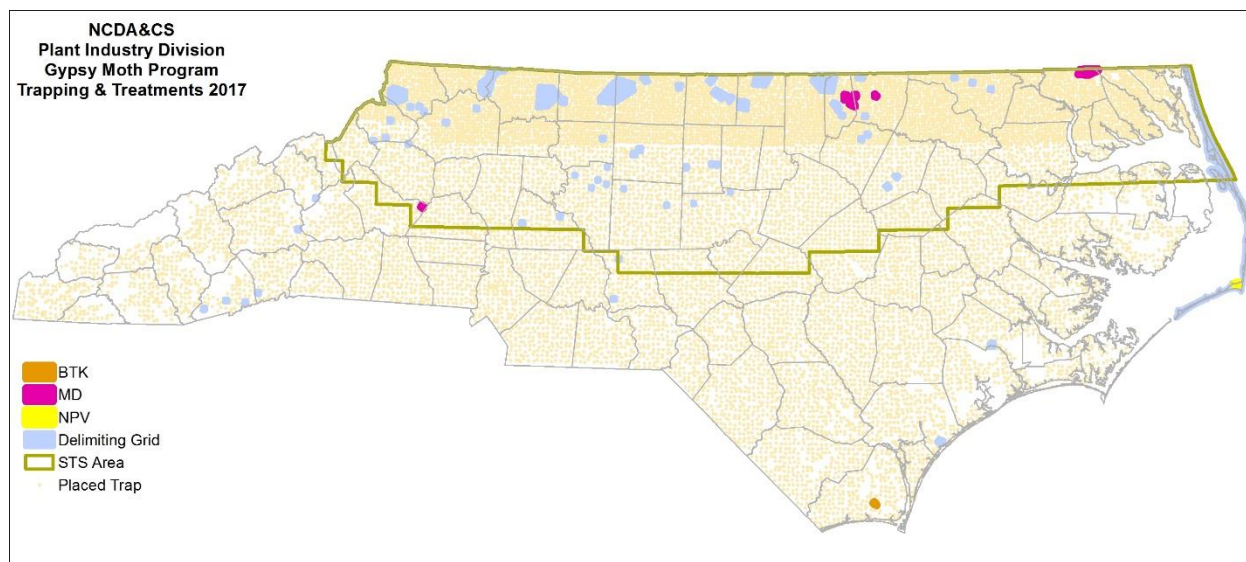


Figure 3. 2017 gypsy moth treatment sites along with delimiting grids and all other traps set.

Table 2. 2017 gypsy moth treatments, county, and acreage. For product, MD = mating disruption, Gypchek = NPV virus, and Btk = *Bacillus thuringiensis* var. *kurstaki*.

Site name	County	Product	Number of Applications	Acres in Block	Total Acres Treated at Site
Bolivia_1	Brunswick	BTK	2	774	774
Buxton_1	Dare	NPV	3	750	750
Corapeake_1	Gates/Camden	MD	1	10143	8500
Longview_1	Burke	MD	1	682	689
Middleburg_1	Vance	MD	1	1770	1540
Middleburg_2	Warren/Vance	MD	1	914	898
Vicksboro_1	Vance/Warren	MD	1	2879	2450
Warrenton_1	Warren	MD	1	640	580

Regulatory

The gypsy moth program also seeks to mitigate the risk of artificial introduction and spread through a comprehensive regulatory program. An area that is generally infested is quarantined so that the movement of certain high-risk articles, such as logs, outdoor household articles, and nursery plants, is strategically restricted per USDA-APHIS-PPQ regulations. In North Carolina, all of Currituck County and a small portion of Dare County were quarantined in 1988. A map of the North Carolina gypsy moth quarantine area is shown in Figure 4.

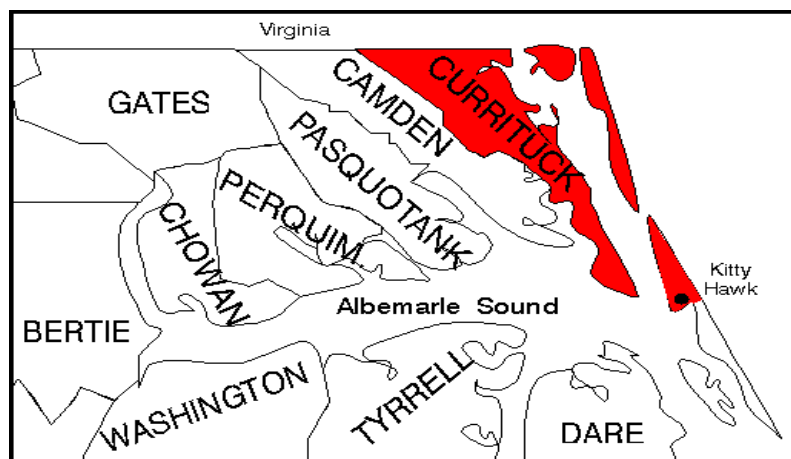


Figure 4. Gypsy moth quarantine in North Carolina, shown in red.

Regulated articles may be moved from quarantined to non-quarantined areas if the appropriate personnel undergo training and submit to the stipulations of a Compliance Agreement with NCDA&CS. These compliance agreements require inspection and/or treatment of articles to ensure that they are free of gypsy moth life stages. A number of businesses and individuals received training for new staff and several new Compliance Agreements were issued.

Public education efforts are also an important part of the regulatory program. Staff visits NC Cooperative Extension and NC Forest Service offices to update county personnel on program changes. Also, program personnel monitor all high-risk locations in the STS program area by the placement and removal of traps. However, NCDA&CS receives no dedicated funding for these efforts, so the future character of the program will be determined by future allocations.

BLUEBERRY CERTIFICATION PROGRAM

The blueberry maggot (Figure 1; *Rhagoletis mendax*; BBM) is a serious pest of both lowbush and highbush blueberries. Infestations of this pest lead to unmarketable berries, reductions in yield, and increased production costs. The maggot is native to eastern North America and is found in the eastern United States, including North Carolina. While native to Nova Scotia, New Brunswick, and Prince Edward Island, the pest was detected in Ontario and Quebec in the mid-1990s—two regions where the maggot had not previously been known to exist. As a result, Canada regulates *R. mendax* to prevent spread of BBM into provinces that are currently free of this pest. The Blueberry Certification Program (BCP) was initiated by the Canadian Food Inspection Agency (CFIA) in 1999 to facilitate the movement of fresh blueberries while managing the risk of further spread of the blueberry maggot into non-infested areas of Canada.

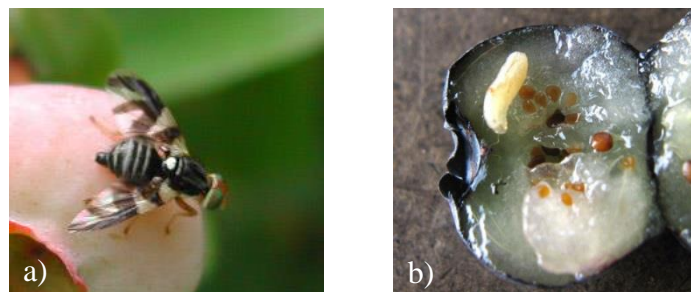


Figure 1. Blueberry maggot (*Rhagoletis mendax*): a) adult; b) larva inside blueberry (Photos by Rufus Isaacs, MSU)

In North Carolina, we currently have 51 blueberry farms located in four southeastern NC counties (Bladen, Duplin, Pender, and Sampson) participating in the Blueberry Certification Program. In May 2017, we mailed out the annual blueberry maggot flight letter informing all growers in the program that they should begin their internal audits. All growers are required to perform a brown sugar or salt flotation test on their berries every three days starting from when they receive their flight letter until they are done packing and shipping for the season. The flotation test involves soaking two pints of gently crushed berries in either a sugar or salt solution for 10 minutes to observe whether any maggots float to the surface (Figure 2; the complete method can be found at <http://www.ncagr.gov/plantindustry/Plant/entomology/BlueberryCertificationProgram.htm>).

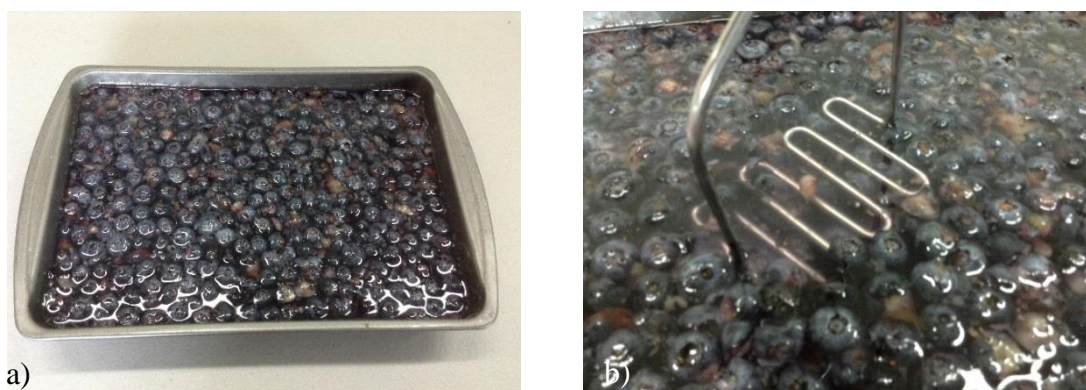


Figure 2. Salt flotation test: a) blueberries soaking in salt water solution for 10 minutes; b) close-up of flotation test showing potato masher used to gently crush berries. (Photos by Whitney Swink, NCDA&CS)

In late May, NCDA&CS Plant Protection personnel began traveling to each farm to perform the annual regulatory audit. The NCDA&CS audit consists of performing the flotation test and checking the calendar spray treatment and/or trapping records (if utilizing IPM) to ensure the growers are following the CFIA BCP regulations. Every single grower in the program elected to use the salt solution (as opposed to the brown sugar solution). The results were negative for all audits performed (both internal and regulatory). Due to a late freeze, 14 of the farms lost 75-100% of their crop this year and, as a result, did not ship to Canada.

In 2016, we switched from using paper forms to using a fillable form in a program called PDF Expert on iPads. This improved the rate at which the data (spray records, internal audit dates, etc.) could be recorded as well as increased organization as the forms could be emailed immediately upon completion of each regulatory audit ensuring all of the records are kept in one place. In 2017, we switched to using Survey 123 to record data collected during the audits which fine-tuned the data collection process even further through use of a “smart form” (a form that modifies the input fields based on the data being collected; e.g. if a grower is using the calendar spray program the form will not ask you questions about IPM trapping results). We plan to continue using Survey 123 in 2018.

IMPORTED FIRE ANT PROGRAM

The Imported Fire Ant (*Solenopsis invicta*; IFA) continues to be a serious pest in the southern United States with infestations occurring in 14 states and Puerto Rico. North Carolina is on the leading edge of the expanding range of fire ants. Currently, 75 of North Carolina’s 100 counties are either partially or entirely infested. NCDA&CS’ objective is to prevent the artificial spread of IFA from infested areas to non-infested areas through regulatory actions.

Blitzes and Surveys

Fire ant blitzes were conducted, as part of the IFA regulatory program in NC, in four locations across the state to enforce that operations moving regulated articles outside the quarantine area in NC are in compliance with federal and state regulations. A total of 38 blitzes were conducted in 2017: 20 in the Spring from 28 February-5 April and 18 in the Fall from 27 September-1 November at the weigh stations in Halifax (I-95 corridor in Halifax County), Lumberton (I-95 corridor in Robeson County), Mt. Airy (I-74 Corridor in Surry County), and Hendersonville (I-26 corridor in Henderson County) (Table 1). Seventy-four vehicles (74) were stopped, of which 45 were stopped at the Halifax weigh station, 16 at the Lumberton weigh station, 11 at the Mount Airy station, and 2 at the Hendersonville weigh station. Drivers were asked if they were transporting IFA regulated articles. Soil samples from 21 vehicles were collected and processed from regulated articles such as potted plant containers and trees, and samples were sent for chemical analysis (NCDA&CS Food and Drug Protection Division Laboratory) to determine the levels of bifenthrin or any other approved pesticides as required by the federal and state regulations. All samples showed detectable levels of bifenthrin, chlorpyrifos, diazinon, fenoxycarb, fipronil, hydramethylon, methoprene, pyriproxyfen and/or tefluthrin in compliance with the levels required by state and/or federal regulations.

Drive-by surveys were conducted in 13 counties in NC in 2017 (Table 2). Data was collected using the Survey 123 app on iPads and included new IFA mounds and established sites. The category “Absent” was also included and indicates sites with no mounds reported. This was used as a way to show all areas surveyed (negative controls).

As a result of surveys conducted in 2016 within the state, Warren County was added to the IFA quarantine at the end of 2017. Additional areas will be considered for quarantine expansion in 2018 utilizing the data collected from the 2017 surveys (Table 2).

TABLE 1. NC IMPORTED FIRE ANT BLITZES SUMMARY (2017)			
Date	Location	Truck stopped	Soil samples collected
28 February 2017	Halifax weigh station	9	4
1 March 2017	Halifax weigh station	9	3
14 March 2017	Halifax weigh station	9	3
15 March 2017	Halifax weigh station	2	1
21 March 2017	Lumberton weigh station	4	2
22 March 2017	Lumberton weigh station	8	1
28 March 2017	Mt Airy weigh station	5	0
29 March 2017	Mt Airy weigh station	5	1
4 April 2017	Hendersonville weigh station	1	1
5 April 2017	Hendersonville weigh station	0	0
27 September 2017	Halifax weigh station	11	1
10 October 2017	Lumberton weigh station	2	1
11 October 2017	Lumberton weigh station	2	1
17 October 2017	Mt. Airy weigh station	1	0
18 October 2017	Mt. Airy weigh station	0	0
24 October 2017	Hendersonville weigh station	1	0
25 October 2017	Hendersonville weigh station	0	0
31 October 2017	Halifax weigh station	3	1
1 November 2017	Halifax weigh station	2	1
Totals	38¹	74	21

¹Corresponds to 19 days and two blitzes per day.

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TABLE 2. IFA SURVEY RESULTS (2017)						
County	Areas Surveyed	Regulatory Action Recommended (*)	Absent	Established sites	New observation	Total
Alamance	5-mile strip from the 2017 quarantine line	No action	252		30	282
Buncombe	SW of Asheville	No action	29	1		30
Burke	10-mile strip from the 2017 quarantine line	No action	80	5	1	86
Caldwell	10-mile strip from the 2017 quarantine line	No action	70	3		73
Davidson	5-mile strip from the 2017 quarantine line	Expansion 2019	205		77	282
Guilford	5-mile strip from the 2017 quarantine line	No action	410		17	427
Henderson	Entire county	No action	16	2		18
Iredell	10-mile strip from the 2017 quarantine line	No action	62	1	10	73
Jackson	Entire county	No action	81	5	1	87
McDowell	10-mile strip from the 2017 quarantine line	No action	87	3	9	99
Orange	5-mile strip from the 2017 quarantine line	No action	178		8	186
Swain	Entire county	No action	123	2		125
Transylvania	Entire county	No action	38			38
Total			1631	22	153	1806

(*): “*No action*” when numbers are not enough to justify a regulatory action. “*Expand*” when partially quarantined counties have shown significant numbers of IFA mounds above the quarantine line. “*Add*” when there is conclusive evidence that a significant number of IFA mounds are detected in a county where no previous mounds have been reported.

COTTON BOLL WEEVIL PROGRAM

Field surveys for the cotton boll weevil (*Anthonomus grandis*) were coordinated and carried out by the NC Cotton Boll Weevil Foundation. In 2017, a total of 363,201 acres were reported in 49 counties (Table 1). Plant Industry Division personnel surveyed cotton gins and cotton processing facilities (n=58) in 36 counties using conventional cotton boll weevil traps, similar to those used for sweetpotato weevil field surveys (Table 2). Traps were baited with a male specific sex pheromone and checked once a month.

Table 1. COTTON ACREAGE BY COUNTY (2017)					
Alamance	0.0000	Gates	8,775.7860	Onslow	1,243.8750
Anson	2,192.7100	Granville	0.0000	Pamlico	0.0000
Beaufort	7,375.2400	Greene	5,602.9500	Pasquotank	1,325.7900
Bertie	19,823.4550	Halifax	41,035.2348	Pender	1,751.7750
Bladen	12,800.7000	Harnett	5,559.3100	Perquimans	7,887.5938
Brunswick	206.1900	Hertford	9,658.0170	Pitt	9,805.9296
Cabarrus	296.1900	Hoke	5,436.5535	Richmond	2,279.5415
Camden	159.9500	Hyde	9,662.8827	Robeson	8,874.3345
Carteret	303.9000	Iredell	0.0000	Rowan	407.5200
Catawba	0.0000	Johnston	3,403.6500	Rutherford	0.0000
Chowan	6,500.5900	Jones	12,825.0700	Sampson	13,189.6550
Cleveland	0.0000	Lee	361.6200	Scotland	2,542.2555
Columbus	1,363.8200	Lenoir	8,510.1100	Stanly	12,161.5157
Craven	5,262.2420	Lincoln	134.9800	Tyrrell	4,557.6100
Cumberland	6,752.3150	Martin	26,972.3546	Union	665.3200
Davidson	324.3900	Mecklenburg	0.0000	Wake	39.5400
Duplin	6,236.3500	Montgomery	240.3050	Warren	286.3000
Edgecombe	25,624.0934	Moore	0.0000	Washington	7,797.1079
Forsyth	0.0000	Nash	6,958.3100	Wayne	5,505.1654
Franklin	0.0000	Northampton	35,002.4262	Wilson	7,518.6972
				Yadkin	0.0000
				Total	363,201.2213

TABLE 2. NUMBER OF COTTON GINS SURVEYED BY COUNTY (2017)					
Anson	1	Gaston	1	Nash	1
Beaufort	1	Gates	1	Northampton	4
Bertie	2	Greene	1	Orange	2
Bladen	1	Halifax	8	Pasquotank	1
Camden	1	Hertford	1	Perquimans	1

Chowan	2	Hyde	1	Pitt	1
Craven	1	Jones	1	Robeson	2
Currituck	2	Lenoir	1	Rowan	1
Duplin	1	Lincoln	1	Sampson	3
Durham	1	Martin	1	Stanly	1
Edgecombe	3	Mecklenburg	4	Wayne	1
Forsyth	1	Montgomery	1	Wilson	1

BROWN GARDEN SNAIL SURVEY

The brown garden snail (*Cornu aspersum*; BGS) was intentionally and illegally introduced into a small area in Kill Devil Hills (Dare County), North Carolina in the mid-1980s as part of a project intended to raise and sell these mollusks to restaurants and businesses (heliculture farming, which is prohibited in North Carolina). BGSs are a non-native species of mollusk that can be a potentially destructive pest for agriculture, and specifically the nursery industry.

Since BGS was reported in North Carolina, and a small population was established in the Kill Devil Hills area, NCDA&CS has been monitoring and containing its spread with periodic applications of molluscicides (Sluggo®) and by manually killing snails.

WALNUT TWIG BEETLE PROGRAM (THOUSAND CANKERS DISEASE)

The walnut twig beetle (*Pityophthorus juglandis*) is a vector of a serious disease of forest trees affecting primarily black walnuts (*Juglans nigra*) and butternuts (*Juglans cinerea*) called thousand cankers disease (*Geosmithia morbida*; TCD). Our plant pathologist, Leah Roberts, currently runs the TCD program and the work done on the program is covered in the plant pathology section of the NCDACS-PID-PPS annual report.

MOVEMENT OF LIVE INSECTS FOR RESEARCH, COMMERCIAL OR EDUCATION PURPOSES

The Entomological Programs Specialist evaluated 78 federal applications for PPQ 526 e-Permits in 2017. No permits were rejected this year. The large number of applications to move insects into North Carolina reflects the continued strong market in entomological research, commerce, and education in the state conducted by our public and private institutions.

CURRENT INSECT QUARANTINES IN NORTH CAROLINA

Regulatory Species	Quarantines as of December 2017
Emerald Ash Borer (<i>Agrilus planipennis</i>)	The entire state of North Carolina was placed under quarantine in 2015.

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Gypsy Moth (<i>Lymantria dispar</i>)	Currituck County. Quarantine area remained unchanged relative to 2016.
Imported Fire Ant (<i>Solenopsis invicta</i>)	The quarantine was expanded to include the entirety of Catawba, Northampton, Rowan, and Rutherford counties and a portion of Burke County. A total of 75 counties are under entire or partial quarantine in NC.
Sweetpotato weevil (<i>Cylas formicarius</i>)	Coastal areas of Brunswick (Caswell Beach) and New Hanover (Carolina Beach and Kure Beach) counties.
Walnut Twig Beetle (<i>Pityophthorus juglandis</i>)	Haywood County. Quarantine area remained unchanged relative to 2016.

NURSERY CERTIFICATION PROGRAM

NCDA&CS' Plant Protection Specialists inspected 4,124 nursery dealers and nurseries during the 2017 season. Nine Stop Sale/Movement notices were issued to prevent the sale of infected or prohibited plants. These plants were either treated, destroyed, or released after lab testing.

A license issued by the NCDA&CS is required by any person selling nursery stock in North Carolina. Nursery stock is defined as "all wild or cultivated plants or parts thereof, trees, shrubs, vines, bulbous plants and roots, grafts, scions and buds." Excluded in North Carolina's definition of nursery stock are "annual plants; cut flowers; tree, field, vegetable, flower or other true seeds; decorative plants or plant parts without roots not intended for propagation; and perennial plants intended for indoor use that are produced in North Carolina." A *nursery license* is required for any person growing and selling nursery stock whereas a *nursery dealer license* is required for any person obtaining and re-selling nursery stock. These licenses certify that plant material has been inspected for and is apparently free from potentially harmful quarantine pests and must be renewed yearly.

The NCDA&CS Plant Protection Section licensed 1,266 nurseries and 2,858 nursery dealers during the 2017 calendar year (Table 1). Of the 1,266 nurseries, 620 were registered nurseries and 646 were certified nurseries. A *registered nursery* has less than one acre of nursery stock and does not sell outside the state. A *certified nursery* has one or more acre of nursery stock and/or sells outside the state.

The data show a slight decrease in the number of nurseries and the number of acres that were certified. This decrease may be a result of changes and uncertainty within the agribusiness sector and its impact on the nursery industry although figures are relatively unchanged. The nursery dealer industry remained relatively stable in the state continuing to offer quality nursery stock to consumers. The stability in nursery production as well as nursery dealer indicates the strength and staying power of North Carolina's nursery industry.

Table 1. Number of NC nursery and nursery dealer licenses by year¹

Calendar Year	Number of Licenses by Category			Total Number of Licenses	
	Registered Nursery ²	Certified Nursery ³	Nursery Dealer ⁴	Nurseries (Registered & Certified)	Nurseries & Dealers
2014	590	654	2,782	1,244	4,026
2015	594	612	3,188	1,206	4,394
2016	642	651	2,957	1,293	4,250
2017	620	646	2,858	1,266	4,124

¹ Data based on receipt of license fees.

² Registered nursery – a location with less than one acre of nursery stock with no sales outside the state.

³ Certified nursery – a location with one or more acre of nursery stock and/or sales outside the state.

⁴ Nursery dealer – a location where nursery stock is sold, usually to the end user, but not actually grown.

The primary objective of Plant Industry's Nursery Program is to facilitate the movement of nursery stock while preventing the introduction and spread of quarantine plant pests into and within North Carolina. The movement of infested nursery stock represents one of the ways plant pests may be moved from one location to another and has the potential to directly impact both wholesale and retail nursery operations. North Carolina works to prevent such outbreaks by coordinating with other states and nursery industry to bring awareness of threats to the state.

Stop sale/movement notices are issued when high levels of pests and/or prohibited plants are noted. Plants can either be treated and/or destroyed when a stop sale/movement notice is issued. Plants can be released for sale/movement if testing of the material confirms they are free of the suspected pest(s). During calendar year 2017, 9 stop sale/movement notices were issued.

Phytosanitary and Export Certification Program

Within the Phytosanitary and Export Certification Program, Plant Protection Specialists issue phytosanitary certificates to growers and/or brokers to facilitate movement of agricultural commodities to other states and to other countries. Phytosanitary certificates indicate that inspections and other specific requirements of the importing states or countries have been met. State certificates are used for movement within the U.S., and federal certificates are required for movement to another country. Countries and states vary greatly in what they require for various types of commodities such that careful research and interpretation of requirements are needed for each request for phytosanitary certification.

A phytosanitary certificate provides documentation that a plant, plant part, or plant-based product has been inspected and is apparently free of harmful pests. Each state and country has very specific import phytosanitary requirements that are tailored to protect their agricultural industries and natural environment from potentially harmful pests.

The NCDA&CS Plant Protection and Export Certification Specialists facilitate interstate and international movement of plants, plant parts, and plant-based products by issuing both state and federal phytosanitary certificates to NC growers and brokers. State and federal phytosanitary certificates are issued for interstate and international movement, respectively. The NCDA&CS is responsible for implementing the state export program while the USDA is responsible for implementing the federal export program. However, the NCDA&CS works in collaboration with the USDA to issue federal phytosanitary certificates to support international export of plant-based products from NC.

Primary use of the USDA PCIT (Phytosanitary Certificate Issuance and Tracking) System to issue federal certificates began in October 2009. The number of federal and state phytosanitary certificates issued using the PCIT system is included in Table 2. In 2017, NCDA&CS staff issued 8,038 federal phytosanitary certificates and 580 state phytosanitary certificates. The number of federal phytosanitary certificates issued in 2017 represented a 8.5% increase from 2016 figures while the number of state phytosanitary certificates issued represented a 17.5% decrease from the previous year. Federal certificates were issued for the movement of commodities to 85 countries, while state certificates were issued for 31 states, Puerto Rico, and the Virgin Islands. The majority of phytosanitary certificates issued were for lumber, tobacco, cotton, cotton seed, Christmas trees, peanuts, nursery and greenhouse plants, sweetpotatoes, and sweetpotato cuttings.

Table 2. Number of phytosanitary certificates issued through the PCIT¹ system

Fiscal Year	Federal				State
	Plant or Plant Part	Re-export	Processed Plant Product	Total	Total
2010/2011	2,781	21	0	2,808	323
2011/2012	4,221	13	18	4,252	206
2013 (Calendar Year)	5,830	15	134	6,658	412
2014 (Calendar Year)	6,980	32	172	7,184	348
2015 (Calendar Year)	6,560	21	162	6,743	561
2016 (Calendar Year)	7,140	17	199	7,356	703
2017 (Calendar Year)	7,932	15	91	8,038	580

¹ PCIT = Phytosanitary Certificate Issuance and Tracking (USDA web-based application)

PLANT CONSERVATION PROGRAM

NORTH CAROLINA PLANT CONSERVATION BOARD

The Plant Conservation Program meets quarterly with members of the NC Plant Conservation Board whose seven members are appointed by the Governor and the Commissioner of Agriculture. Members in 2016 included: Kathy Schlosser (chair) Les Hunter, Steve Henson, Alexander Krings, David Hyatt, Jonathan Lanier, and Peter White.

Peter White of the NC Botanical Garden retired at the end of 2014; he will continue to serve pending a Governor-appointed replacement of an NC Botanical Garden representative. Damon Waitt, the new Director of the NC Botanical Garden attended NC Plant Conservation Board meetings in an unofficial capacity in 2017.

In 2017, the Board completed and approved an update to the policy titled **Policies & Practices of PCP which describes the authority to and process for PCP to acquire land for the protection of native plant species in North Carolina. They also approved an appendix to this policy drafted by the Scientific Committee regarding a background for policies** on trails and public access to North Carolina Plant Conservation Program Preserves.

NORTH CAROLINA PLANT CONSERVATION SCIENTIFIC COMMITTEE

PCP meets regularly with members of the NC Plant Conservation Scientific Committee. This seven member committee consists, primarily, of positions designated to the committee by law. Members include Alan Weakley (chair), Dennis Niemeyer, Richard Braham, Johnny Randall, Hervey McIver, Laura Robinson and Jerry Reynolds.

The Committee continued work on updating the NC protected plant list following procedures and protocols established during the last update in 2008. The Committee will suggest additions, deletions, and technical changes once PCP staff completes necessary analyses and ensures a thorough review of any changes to trends and threats of individual imperiled species. **The Committee finalized** work on developing an Appendix B to the “Practices” document which would include a policy for public access to PCP Preserves and references for further reading on the topic.

PLANT CONSERVATION PRESERVE SYSTEM

PCP and Board have the regulatory authority to establish Plant Conservation Preserves to protect imperiled plant species. These Preserves are the only state-managed lands selected and designed specifically for plant conservation purposes. The Preserve system consists of 24 Preserves distributed across North Carolina (Figure 1). Although no new Preserves were added in 2017, 180 additional acres were added to the Tater Hill Preserve in Watauga County. These added acres provide additional protected plant habitat and important natural communities to the preserve system making the conservation value of this preserve more robust. Ten acres were added to the western part of the preserve from the Pardue Tract. The larger 170-acre acquisition was Phase I of a two phase project to protect Harmon Knob, adjacent to the Rich Mountain Bald and Tater Hill Seeps and Bogs which the preserve currently protects. In October 2017, the Clean Water Management Trust Fund awarded funding to the Blue Ridge Conservancy to acquire 199 acres for Phase II of this project to expand the Tater Hill Preserve. Blue Ridge Conservancy will transfer the property to the state after purchase.

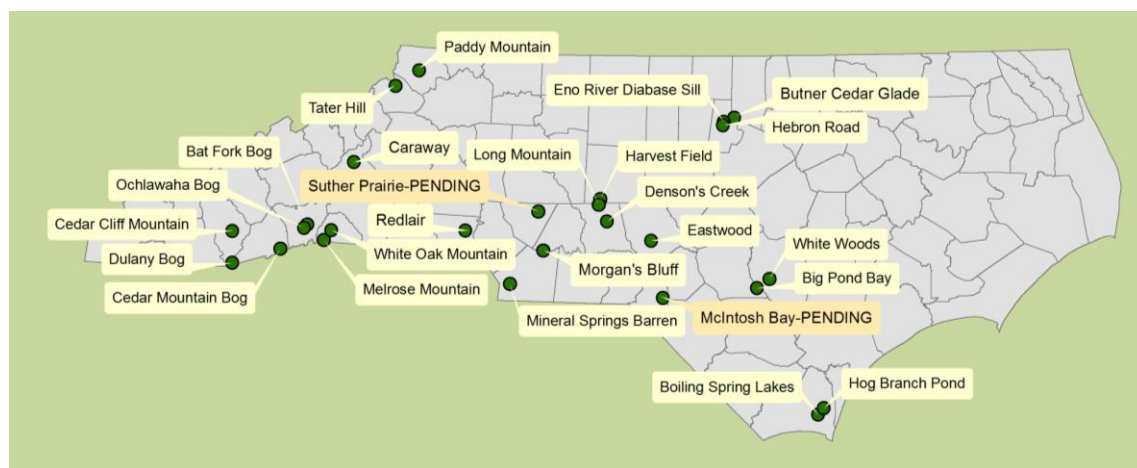


Figure 1. PCP Preserve System

Two new properties (Suther Prairie and McIntosh Bays) are pending acquisition into the Preserve System (see map above). The former is a project being undertaken by the Cabarrus County Soil and Water Conservation District with the plan to transfer the property to PCP for permanent protection. This site contains a wet meadow with two protected plant species, the red Canada lily (*Lilium canadense* ssp. *editorum*) and small sundrops (*Oenothera perennis*). The latter acquisition is a collaborative project between The Nature Conservancy (TNC) and PCP whereby TNC has purchased the property from the private land owner and is in the process of conducting restoration activities before selling the property to PCP as a new Preserve. This site is home to eight protected plant species plus an extirpated record of federally endangered Canby's dropwort (*Oxypolis canbyi*). Both projects are expected to close in 2018.

PRESERVE FIELD TRIPS

PCP staff's outreach efforts included public lectures, preserve field trips, and volunteer workdays. Due to concerns about resource damage and plant poaching, PCP conducts guided preserve tours open to the public. Access by researchers and educators is by permit only. Each trip provides participants the opportunity to observe rare plants, while also learning more about land management and ecological stewardship. Staff scheduled tours on preserves in 2017 and responded to various requests for tours and public presentations. Eight guided tours were conducted at White Woods, Caraway, Butner Cedar Glade, Redlair, Eno River Diabase Sill, Bat Fork Bog, Paddy Mountain, and the pending McIntosh Bays preserve, reaching citizens across the state. One additional scheduled preserve tour was unfortunately cancelled due to bad weather at Cedar Cliff Mountain.

PARTNERSHIP & OUTREACH PROJECTS

The Plant Conservation Program is a member of several statewide or regional conservation partnerships and staff participates in these partnerships as time allows. The PCP has also continued to work closely in partnership with conservation organizations and land trusts across the state in land acquisition and management as well as regional consortiums such as the Bog Learning Network, the Greater Uwharrie Conservation Partnership, and Cape Fear Arch. Also of note, PCP has expanded its partnerships with the NC Museum of Natural Science, the NCDA&CS Research Stations, and the NC Forest Service offices and personnel around the state.

In addition, staff regularly reaches out to the public with special presentations and by filling information requests. In 2017, staff gave presentations from Henderson County to New Hanover County for festivals such as Fire in the Pines and groups like the Master Gardner's, NC Botanical Garden, and for the Friends of Plant Conservation programs.

PCP staff supported and helped plan the Rare Plant Conservation Discussion Meeting in March, cohosted by the NC Botanical Garden and the NC Zoo. These meetings provide a venue for presentation of new research as well as to hold discussions and pose questions regarding rare plants. These meetings are attended by faculty and students of multiple universities as well as staff from numerous state and federal agencies and provides a good opportunity for PCP to keep current and possible partners abreast of important news related to PCP.

CLEAN WATER MANAGEMENT TRUST FUND

PCP staff did not prepare grant applications to the Clean Water Management Trust Fund (CWMTF) in 2017. However, we were represented in partner applications for fee simple purchases that would be transferred to PCP as new Preserves or additions to Preserves. In 2017, PCP partners submitted two applications to CWMTF and received funding for one of them. PCP staff worked closely with the NCDA&CS Property and Construction Office to carry out previously awarded grant contracts with closings occurring at Tater Hill and Paddy Mountain and progress made on each of the remaining contracts. Active contracts in 2017 include:

- Additional property acquired at Tater Hill Preserve (Watauga Co.)
- Additional property acquired at Paddy Mountain Preserve (Ashe Co.)
- Boundary adjustment at Tater Hill Preserve (Watauga Co.)
- New preserve acquisition at McIntosh Bays (Scotland Co.)
- New preserve acquisition at Suther Prairie (Cabarrus Co.)

UNITED STATES FISH & WILDLIFE SERVICE (USFWS) PARTNERSHIP

PCP and USFWS continued a long-standing cooperative agreement related to the recovery of endangered and threatened plant species in North Carolina. Grant funds obtained under this cooperative agreement provide critical funds to North Carolina each year. This funding covers the program's research specialist position. A portion of the remaining funds support PCP temporary employees for part of the year. The funding from this partnership supports imperiled plant monitoring, preserve management targeted towards federally-listed, candidate, and at-risk plant species, and regulatory programs including protected plant permit evaluation and issuance.

USFWS REVERTED FUNDS GRANTS

Intermittently, USFWS offers grant opportunities for reverted Section 6 funds to cooperating states, this regional and national competition awards funds to high priority conservation projects. In 2017, PCP was awarded funding for two applications submitted in January and November 2017: "*Reintroducing Two Federally Listed Wetland Species, White fringeless orchid (Platanthera integrilabia) and Canby's dropwort (Oxypolis canbyi)*," and "*Rare Species Management to Support Recovery and Potential Downlisting*". Unlike the traditional Section 6 funds, each of these reverted funds grants cover two years of work.

REGULATORY PROGRAMS

PCP is responsible for the protection and conservation of 419 plant species across NC, of which 27 are also federally listed. Staff meets quarterly with an interagency panel to review permit requests for projects affecting these protected plant species. PCP staff continues to review requests for permits from individuals or institutions requesting to move or collect protected plants, including all state and federally listed plant species in the state. This permit requirement applies to transplant and rescue projects, nurseries which propagate and sell protected species, public educational exhibits, as well as many scientific research projects. The review process incorporates input from the US Fish and Wildlife Service and NC Natural Heritage Program. Sixteen protected plant permits were issued and several additional requests were evaluated during 2017. PCP works with the Plant Protection Section to issue Certificates of Origin for protected plant species being propagated for sale as part of the nursery inspection process carried out by inspection specialists.

Venus Flytrap

No new projects involving Venus flytraps (*Dionaea muscipula*) were begun in 2017. PCP staff continued to monitor repatriated plants on PCP Preserve land which had been confiscated from poachers. The USFWS was petitioned by a private individual in 2016 to list this species federally.

PCP was not involved in this petition process but became aware of it in collaboration with USFWS. In December 2017, the USFWS 90-day finding decided this species presented substantial scientific or commercial information to indicate that the petitioned actions may be warranted. This warranted finding sets in motion the process to further review the species with a Species Status Assessment which is an analytical approach developed by the Service to deliver foundational science for informing all Endangered Species Act (ESA) decisions. After that, then a 12-month finding is reported, a decision regarding whether the species warrants listing under the ESA.

American ginseng

American ginseng (*Panax quinquefolius*) harvest and exports from North Carolina continued under regulations adopted by the NC Plant Conservation Board. Without monitoring by PCP, harvest and export from North Carolina will not be allowed by federal authorities who have listed this plant under the Convention on International Trade in Endangered Species (CITES). The harvest season for American ginseng is September 1st through December 31st. The buying season for wild or wild-simulated green ginseng is September 1st through March 31st. The buying season for wild or wild-simulated dry ginseng is September 15th through March 31st.

NCDA & CS certified over 5,700 pounds of calculated dry/wild collected ginseng during the 2016 - 2017 season representing 31 North Carolina counties. A total of 50 ginseng dealer license permits were issued during the 2016 - 2017 season.

Galax

The sale of wild-collected Galax (*Galax urceolata*) is regulated in North Carolina within a stated buying season which prohibits harvest during the early growing season to allow for new leaves to emerge and grow. Similarly, the US Forest Service which allows for this plant to be harvested from some national forests, also has a harvest ban during the early growing season. In an effort to align these two seasons to eliminate confusion, the PCP Board changed the state buying season to match that of the USFS. Effective January 20, 2016, Galax (*Galax urceolata*) may only be legally bought or sold during the buying season of June 15th through April 15th.

PRESERVE MANAGEMENT

The Program continues striving to manage Preserves for the benefit of the rare plant species and habitats present on these sites and to conduct sufficiently detailed monitoring to determine the status of rare species at these sites. Some examples are as follows:

Controlled Burning Program

Prescribed burning is one the most pressing management needs across the Preserve system and around NC to enhance rare species populations and improve habitats for these species. Following new procedures effective in 2014, staff were able to conduct prescribed burns at 9 units across 4 preserves with the direct assistance of the NCFS during this past year. PCP continues to be responsible for all phases of burn planning and preparation as well as mop-up after the burns were conducted. Staff have been in contact with numerous NCFS District and County offices around the state to begin further collaboration for the upcoming year.

Preserve Highlights:

Bat Fork Bog Preserve (Henderson Co.): staff began collaborating with Dr. Bridget Lassiter, Weed Specialist with the Plant Industry Division, to develop a treatment plan for optimal herbicide control methods for the highly invasive reed canary grass (*Phalaris arundinacea*). PCP and Support Operations staff were encouraged to see quick results from the initial treatment in June, with no *Phalaris* resprouting throughout 2017. The second treatment in July focused on areas unreachable during the first treatment, resulting in approximately 75% of the total infested area being treated in 2017. PCP will monitor resprouts in the spring of 2018 and plan additional treatments with Support Operations staff. Part of the long-term goal for this preserve is to restore the artificial meadow to a swamp forest like the adjacent areas of the preserve and to restore habitat for the existing and extirpated protected plant species known to this site.

Boiling Spring Lakes & Hog Branch Ponds (Brunswick Co.): The use of mechanical mulching and midstory removal continued in 2017 to restore longleaf pine savannas and pond pine flatwoods which have become heavily overgrown with shrubs. In many cases, the mulching machine is used to prepare burn units to allow for a safer controlled burn by removing ladder fuels and thus reducing the fire intensity. Twenty-five acres were mulched along with 225 acres burned in collaboration with the NCFS (123 acres were the result of a wildfire that occurred in March).

Butner Cedar Glade (Granville Co.): PCP staff worked to control invasive species such waxyleaf privet (*Ligustrum quihoui*), nandina (*Nandina domestica*), and Japanese stilt grass (*Microstegium vimineum*). Element Occurrence data were collected for several rare species and submitted to the Natural Heritage Program.

Eno Diabase Sill Preserve (Durham Co.): PCP staff conducted several different activities on the Preserve during the year. Staff spent time thinning the midstory to open the canopy and facilitate effective prescribed burns. Staff and volunteers performed extensive control activities to reduce invasive species such as Japanese stilt grass, sericea lespedeza (*Lespedeza cuneata*), and Queen Anne's lace (*Daucus carota*) as well as numerous other invasive plants. More than a mile of fire

line was refreshed in preparation for burning the site. Prescribed burns were conducted on three tracts comprising 29 acres to improve habitat for imperiled species.

Since discovering the Michaux's sumac (*Rhus michauxii*) population in 2014, PCP staff and stewards have annually examined the flowers and except for a few perfect flowers, only male plants had been observed. However, this year, Preserve Stewards Herb and Pat Amyx found five plants in fruit. Mature fruits were collected and sent to the NC Botanical Garden for propagation and eventual population augmentation. Although PCP is managing this population, the plants are growing in the right-of-way of a defunct railroad, not within the property boundary of the PCP preserve. PCP staff are hopeful that this population will expand into the protected property where we can better manage them and their habitat. Given that very few Piedmont populations of Michaux's sumac have both male and female plants, the possibility of having some natural regeneration at this protected site is especially encouraging.

In late summer, several federally endangered smooth coneflowers (*Echinacea laevigata*) propagated from seed collected at the Preserve were planted back on site to augment the existing population.

Hebron Road (Durham Co.): Control lines for upcoming prescribed burns were installed around a small portion of the Preserve and existing lines were refreshed for a 3-acre burn accomplished in October, a first burn on record for this portion of the property. Efforts to control invasive exotic species were conducted by staff, focusing primarily on Japanese stilt grass (*Microstegium vimineum*) and hairy jointgrass (*Arthraxon hispidus*). In the fall, 45 federally endangered smooth coneflowers (*Echinacea laevigata*) that had been grown from seed collected on site were planted to augment the existing population.

Pondberry Bay Preserve (Sampson Co.): While staff visited the site in late 2016, there was notable pine beetle damage observed. Staff worked with NCFS to complete an assessment of the damage and decide on options for treatment. It was decided with the extent of the damage, to harvest the entire 70-acre unit to avoid further spread of the beetles elsewhere in the property. A contract was developed and harvest was completed in December. A growth of loblolly pine (*Pinus taeda*) is expected next year, so staff will anticipate burning in 2 years to suppress these undesirable species. Additionally, a controlled burn will prepare the ground for planting the target species, longleaf pine (*Pinus palustris*).

Redlair (Gaston Co.): PCP Staff and volunteer steward Haywood Rankin worked to control invasive species such as wisteria, Chinese privet, autumn olive (*Elaeagnus umbellata*), Japanese stilt grass, and hairy jointgrass across the Preserve. Planning was initiated with the stewardship committee devoted to advising PCP staff on management of this Preserve to grow native woody plants to restore areas following treatment for heavy invasive plant infestations.

In conjunction with the Redlair Stewardship Committee, an Implementation Plan was completed which outlines the stewardship needs at the Preserve. After which, a Memorandum of Understanding was developed with Catawba Land Conservancy (CLC) to enhance cooperation

and communication regarding the long-term protection of the Redlair Preserve and other conservation issues within the geographic regions of overlapping interest. CLC owns 350 acres adjacent to the 732-acre state-owned parcel. PCP and CLC are committed to working together to identify conservation projects and opportunities that meet shared priorities and goals in Greater Redlair (the State-owned preserve and adjacent tracts of the CLC owned properties) as a single conservation entity supported, as necessary, by funds from the Redlair Foundation.

RARE SPECIES MONITORING

Understanding the current status and trends of the populations we protect is very important. To that end, we have been collecting flowering data on several species across the state. In 2017, census and/or population monitoring work was conducted for the following species:

Federally listed:

- bunched arrowhead (*Sagittaria fasciculata*)
- Heller's blazing star (*Liatris helleri*)
- Michaux's sumac (*Rhus michauxii*)
- mountain sweet pitcher plant (*Sarracenia jonesii*)
- swamp pink (*Helonias bullata*)
- Schweinitz's sunflower (*Helianthus schweinitzii*)
- smooth coneflower (*Echinacea laevigata*)
- white irisette (*Sisyrinchium dichotomum*)

State listed:

- Gray's lily (*Lilium grayi*)
- tall larkspur (*Delphinium exaltatum*)
- wood lily (*L. philadelphicum*)

Federal Species under review:

- montane purple pitcher plant (*Sarracenia purpurea* var. *montana*)

A qualitative assessment of bunched arrowhead indicates a stable or increasing population at Bat Fork and Ochlawaha Bog Preserves. PCP and National Park Service staff used NPS developed protocol to tag and collect population data at the Heller's blazing star occurrence at Paddy Mountain Preserve. A census of seven smooth coneflower populations was conducted as part of an ongoing project to determine population trends for this species in North Carolina. Flowering trends for Schweinitz's sunflower, are relatively stable to apparently increasing across PCP Preserves. Flower production among mountain sweet pitcher plant and purple mountain pitcher plant populations was monitored at Cedar Mountain Bog Preserve. The Dulany Bog site had a new

record of montane purple pitcher plant documented in 2017; the plants were previously only known to the portion of the site owned by the Highlands Biological Foundation. PCP will continue to monitor this site to document new natural recruitment. The swamp pink population adjacent to the Bat Fork Bog Preserve was monitored—this population grows on a parcel PCP is funded to purchase to provide better protection to this species as well as additional patches of bunched arrowhead. PCP staff monitored for white irisette at White Oak Mountain and Melrose Mountain Preserves. As mentioned earlier, the Michaux's sumac population on PCP land in Durham Co. was observed as part of an ongoing monitoring effort.

Lastly, at Tater Hill Preserve, monitoring occurred for Gray's lily, wood lily and tall larkspur. Evidence of lily leafspot disease was observed and confirmed with laboratory testing. PCP has coordinated with NC Botanical Garden staff to begin planning a seed collecting effort next year given the very low seed production rate due to early dieback caused by lily leafspot disease.

STEWARD ACTIVITY

Many of the management projects at the Durham Preserves (Hebron Road and Eno Diabase Sill) have been enhanced with the reliable help from two volunteer stewards who travel from Wake County to participate in a panoply of activities including, but not limited to, prescribed burn preparations, trash pick-up, invasive species control, seed plot establishment, seed collection, lead guided tours, etc. Herb and Pat Amyx are heading up augmentation efforts for smooth coneflower, state Endangered tall larkspur (*Delphinium exaltatum*), and state Threatened smooth aster (*Symphyotrichum leave var. concinnum*) at our Durham County preserves. For several years they have helped collect seed and propagate seedlings to return to the appropriate Preserves. These efforts have significantly increased the size of several of our smallest smooth coneflower subpopulations, and our only known population of smooth aster.

The Bat Fork Bog (Henderson Co.) volunteer steward, Tom Baugh, performed a variety of monitoring duties at the Preserve. He assisted in improving the understanding of the spatial extent and spread of imperiled and invasive species on the Preserve.

Stewards at Harvest Field (Randolph Co.), Mimi Westervelt & Kathy Schlosser, maintained augmented Schweinitz's sunflower individuals and participated in annual monitoring efforts.

Nancy Adamson, volunteer steward at Denson's Creek (Montgomery Co.) provided assistance in invasive plant management at this preserve.

The Redlair Preserve (Gaston Co.) volunteer steward and prior landowner, Haywood Rankin, continues to contribute an extraordinary amount of time to the management of the preserve (on average 80+ hours per month). Haywood divides his time at the preserve between invasive plant control, monitoring for invasive species, as well as boundary checks and addressing trespass

issues. Haywood also leads tour groups and permitted researchers at this large preserve on behalf of the PCP Staff, increasing our capacity for engaging the public at this site.

The Cedar Mountain Bog (Transylvania Co.) volunteer steward, Torry Nergart, Conservation Easement Manager with Conserving Carolina, a long-time partner of PCP in the southern mountain region, was a tremendous help to PCP staff this year. He recruited and led volunteers on management workdays to remove invasive plants and to help mark the boundaries of the property. Torry is also helping to monitor the Ochlawaha Bog (Henderson Co.) and facilitate neighbor conversations. PCP hopes to deepen the collaboration between our office and CMLC for advertising volunteer stewardship activities.

The Tater Hill Preserve (Watauga Co.) volunteer steward, Matt Estep who is a professor at Appalachian State University researching evolution and population genetics of rare plants, has been a enormous help to PCP staff this year. He and several of his graduate students are undertaking monitoring and management projects and facilitating property boundary marking at the preserve. Matt is also an invaluable resource for connecting with other neighbors in the small community who live along Replogle Drive.

NCDA&CS Plant Pathology Program

Boxwood Blight

Boxwood Blight Statement Program

In February 2012, NCDA&CS developed an optional “Boxwood Blight Statement Program.” Under the program, a NC nursery receives a statement to accompany shipments into other states. The participating nurseries are signees to a compliance agreement and follow best management practices. To facilitate this program, the NCSU Plant Disease and Insect Clinic assays samples collected during this process at no charge. As of December 2017, there are 78 participants in the program.

Cut greenery issue

Boxwood greenery is a common component of holiday wreaths and garlands. The process of individuals going from field to field to cut this greenery is a pathway for the spread of boxwood blight. In addition, using infected greenery in holiday decorations provides a pathway by which the disease can spread into home landscapes. In September of 2017, NCDA&CS sent a letter to statement program participants concerning the risks posed by activities related to the use of boxwood as cut greenery. Despite this, infected greenery was found at several retail stores in November and December, resulting in stop sales. NCDA&CS worked within North Carolina and reached out to other affected states to encourage timely destruction of all infected greenery.

Farm Bill funded sanitizer research

NCDA&CS received Farm Bill funding to evaluate sanitizers against the boxwood blight pathogen, *Calonectria pseudonaviculata*. One of the best methods for mitigating losses due to boxwood blight is the use of good sanitation practices. Disinfectants are a critical component of sanitation. Sufficient contact times for commonly used disinfectants such as alcohol solutions and Lysol spray are difficult to achieve under field conditions due to the quick evaporation of these products.

In addition, the emergence of boxwood blight has effected the logistics of trucking and delivery. Many nurserymen now have truckers agree not to deliver commingled loads from multiple nurseries and to rinse containers and trucks between loads. Many products commonly used by the trucking industry have not been evaluated for efficacy against *C. pseudonaviculata*.

More effective products with surfactants and foaming agents are needed to achieve sufficient coverage and contact time on large equipment, trucks, and containers. This project tests products or combinations of products that have not previously been evaluated, with the logistics of large, field-grown nursery production and shipping operations in mind.

The following sanitizers were tested:

- Greased Lightning Super Strength Cleaner and Degreaser
- Purple Power Concentrated Industrial Strength Cleaner/Degreaser

- Virkon S (DuPont)
- Star San acid sanitizer
- Purell Professional Surface Disinfectant

All sanitizers were tested at label strength. In addition, 95% ethanol was used as a positive control and sterile, distilled water was used as a negative control.

The disinfectants tested in these trials proved to have efficacy against *Cps*. However, these results should only be taken as a first step warranting further evaluation of the products. The data collection methods are qualitative (fungal growth or no growth). Therefore, more work should be done to develop ideal application rates and contact times. Future studies should quantify spore death over time for each product. This work is significant in that it indicates that several previously untested products show some degree of efficacy against this important pathogen.

Sudden Oak Death (SOD) Survey – see CAPS section

Recurring positive location

Ornamental plants at a nursery dealer in Mecklenburg County have tested positive for the plant pathogen, *Phytophthora ramorum*, at various times since the first detection in 2008. The NCFS also conducts water sampling in the stream directly outside of the nursery as part of a USFS regional stream-baiting project. The stream tested positive for *P. ramorum* in spring of 2017.

Trace-forward/trace-back notifications

USDA-APHIS-PPQ notifies NCDA&CS when a nursery in another state has plants test positive for *Phytophthora ramorum* infection. If the positive nursery has recently sent host plants to NC, a trace-forward event occurs, the plants in question are inspected, and possible regulatory action is taken. No trace notifications occurred in 2017.

Host List Review

The Plant Pathologist participated in a working group charged with making recommendations for revisions to the *P. ramorum* “Hosts and Associated Plants” list maintained by USDA APHIS PPQ.

Miscellaneous

The Plant Pathologist participates in monthly, national conference calls pertaining to the Sudden Oak Death program and provides summaries to the Plant Pest Administrator. Monthly conference call participants routinely discuss issues such as: changes to national regulations, current trace-forward/trace-back investigations, updates from regulated states, on-going research, and workshop/training announcements.

Thousand Cankers Disease

Thousand Cankers Disease threatens eastern black walnut (*Juglans nigra*), a high value, ecologically, and culturally important tree species in North Carolina. The disease is caused by a fungus, *Geosmithia morbida*, spread by the walnut twig beetle (*Pityophthorus juglandis* Blackman (Coleoptera: Scolytidae)) and can kill trees in as few as three years once symptoms appear. Thousand cankers disease may also infect butternut trees (*Juglans cinerea*).

In 2017, NCDA&CS received federal Farm Bill funding to conduct surveys for the walnut twig beetle and thousand cankers disease. Surveys spanned 19 counties throughout North Carolina. Trapping occurred predominately in western and central areas of the state where black walnut occurs in greater numbers. Special focus was placed around Haywood County, the only location in the state where TCD is known to occur and a quarantine is in place. A total of 38 Lindgren multi-funnel traps were set in June 2017. Samples were collected every two weeks for eight weeks. No walnut twig beetles were detected, to date.

Work was also conducted to identify novel insect-pathogen relationships for *G. morbida*. To do this, a subset of bark and ambrosia beetles (not walnut twig beetle) caught during the survey will be sent to the USFS for molecular analysis. This work is on-going and results are pending. Several beetle species collected in this manner in 2016 tested positive for *G. morbida*.

Table 1. WTB trap locations and sample collection dates for 2017.

Trap ID	County	Longitude	Latitude	Trap Set	Sample Collection Dates			
					1	2	3	4
NC-TCD-2017-AVE-1	Avery	- 82.01051 122	35.95141 24	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17
NC-TCD-2017-AVE-2	Avery	- 82.01046 235	35.97135 27	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17
NC-TCD-2017-BUN-1	Buncombe	- 82.75739 118	35.62750 025	6/20/20 17	6/27/20 17	7/13/20 17	7/24/20 17	8/2/201 7
NC-TCD-2017-BUN-2	Buncombe	- 82.45877 942	35.77711 764	6/20/20 17	6/27/20 17	7/13/20 17	7/24/20 17	8/7/201 7

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NC-TCD-2017-CAR-1	Carteret	- 76.62729 677	34.71025 3	6/9/201 7	6/22/20 17	7/13/20 17	7/31/20 17	8/11/20 17
NC-TCD-2017-CAR-2	Carteret	- 76.85151 787	34.79789 267	6/9/201 7	6/22/20 17	7/13/20 17	7/31/20 17	8/11/20 17
NC-TCD-2017-CHA-1	Chatham	- 79.17626 085	35.70431 993	6/7/201 7	6/22/20 17	7/5/201 7	7/19/20 17	8/3/201 7
NC-TCD-2017-CHA-2	Chatham	- 79.17378 886	35.72701 565	6/8/201 7	6/22/20 17	7/5/201 7	7/19/20 17	8/3/201 7
NC-TCD-2017-DUR-1	Durham	- 78.90934 962	36.06776 806	6/8/201 7	6/22/20 17	7/6/201 7	7/21/20 17	8/4/201 7
NC-TCD-2017-DUR-2	Durham	- 78.90513 788	36.00575 786	6/8/201 7	6/22/20 17	7/6/201 7	7/21/20 17	8/4/201 7
NC-TCD-2017-FOR-1	Forsyth	- 80.28721 757	36.10822 746	6/5/201 7	7/5/201 7	7/13/20 17	7/31/20 17	8/14/20 17
NC-TCD-2017-FOR-2	Forsyth	- 80.40461 568	35.99704 26	6/5/201 7	7/5/201 7	7/13/20 17	7/31/20 17	8/14/20 17
NC-TCD-2017-JAC-1	Jackson	- 83.14459 6	35.21520 8	6/8/201 7	6/22/20 17	7/6/201 7	7/20/20 17	8/3/201 7
NC-TCD-2017-JAC-2	Jackson	- 83.13274 2	35.22451 9	6/8/201 7	6/22/20 17	7/6/201 7	7/20/20 17	8/3/201 7
NC-TCD-2017-MAD-1	Madison	- 82.82944 755	35.71035 712	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17

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NC-TCD-2017-MAD-2	Madison	- 82.78431 368	35.70645 703	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17
NC-TCD-2017-MIT-1	Mitchell	- 82.19597 616	36.01482 314	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17
NC-TCD-2017-MIT-2	Mitchell	- 82.14580 351	35.98031 685	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17
NC-TCD-2017-NEW-1	New Hanover	- 77.92311 142	34.23963 084	6/6/201 7	6/20/20 17	7/7/201 7	7/21/20 17	8/14/20 17
NC-TCD-2017-NEW-2	New Hanover	- 77.92628 456	34.23944 611	6/6/201 7	6/20/20 17	7/7/201 7	7/21/20 17	8/11/20 17
NC-TCD-2017-ONS-1	Onslow	-77.5	34.99527 778	6/9/201 7	6/22/20 17	7/13/20 17	7/31/20 17	8/16/20 17
NC-TCD-2017-ONS-2	Onslow	-77.5	34.99527 778	6/9/201 7	6/22/20 17	7/13/20 17	7/31/20 17	8/16/20 17
NC-TCD-2017-ORA-1	Orange	- 79.00588 148	36.07399 644	6/8/201 7	6/22/20 17	7/6/201 7	7/21/20 17	8/4/201 7
NC-TCD-2017-ORA-2	Orange	- 79.10004 261	36.07778 85	6/8/201 7	6/22/20 17	7/6/201 7	7/21/20 17	8/4/201 7
NC-TCD-2017-SUR-1	Surry	- 80.71120 34	36.37066 154	6/13/20 17	6/26/20 17	7/10/20 17	7/25/20 17	8/7/201 7
NC-TCD-2017-SUR-2	Surry	- 80.60127 29	36.48955 59	6/13/20 17	6/26/20 17	7/10/20 17	7/25/20 17	8/7/201 7

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NC-TCD-2017-SWA-1	Swain	- 83.23566 7	35.26499 7	6/8/201 7	6/22/20 17	7/6/201 7	7/20/20 17	8/3/201 7
NC-TCD-2017-SWA-2	Swain	- 83.23279 3	35.27092 8	6/8/201 7	6/22/20 17	7/6/201 7	7/20/20 17	8/3/201 7
NC-TCD-2017-WAK-1	Wake	- 78.65713 807	35.77438 229	6/8/201 7	6/22/20 17	7/6/201 7	7/21/20 17	8/4/201 7
NC-TCD-2017-WAK-2	Wake	- 78.68641 136	35.79948 429	6/8/201 7	6/22/20 17	7/6/201 7	7/21/20 17	8/4/201 7
NC-TCD-2017-WAT-1	Watauga	- 81.67228 399	36.20283 643	6/22/20 17	7/6/201 7	7/24/20 17	8/3/201 7	8/15/20 17
NC-TCD-2017-WAT-2	Watauga	- 81.65692 147	36.25362 222	6/22/20 17	7/6/201 7	7/24/20 17	8/3/201 7	8/15/20 17
NC-TCD-2017-WIL-1	Wilkes	- 81.30299 267	36.03239 471	6/13/20 17	6/26/20 17	7/10/20 17	7/25/20 17	8/7/201 7
NC-TCD-2017-WIL-2	Wilkes	- 80.93761 588	36.21602 389	6/13/20 17	6/26/20 17	7/10/20 17	7/25/20 17	8/7/201 7
NC-TCD-2017-YAD-1	Yadkin	- 80.51677 938	36.25653 132	6/13/20 17	6/26/20 17	7/10/20 17	7/25/20 17	8/7/201 7
NC-TCD-2017-YAD-2	Yadkin	- 80.93761 588	36.21602 389	6/13/20 17	6/26/20 17	7/10/20 17	7/25/20 17	8/7/201 7
NC-TCD-2017-YAN-1	Yancey	- 82.34792 992	36.01015 676	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17

NC-TCD-2017-YAN-2	Yancey	- 82.32579 072	36.01818 57	6/13/20 17	6/29/20 17	7/11/20 17	7/24/20 17	8/10/20 17
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White Pine Blister Rust

White Pine Blister Rust regulations prohibit the growing of *Ribes* species (currants and gooseberries) in NC because *Ribes* spp. are necessary alternate hosts to the white pine blister rust pathogen, *Cronartium ribicola*. The regulations were put in place to protect the white pine industry. Re-evaluation of this regulation will occur in 2018. Work towards this end has begun and will include consultation with representatives of the NC Forest Service, US Forest Service, and NC State University as well as other state departments of agriculture that have lifted similar *Ribes* bans in recent years.

Forest Pest Outreach

An on-going goal of the outreach program is to reach certain audiences with workshops and oral presentations. Through coordination with the NC Dept. of Environmental Education, workshops have become targeted at teachers and informal educators with a “train the trainer” format. Three in depth workshops were given, along with several oral presentations. Presentations generally covered the most imminent invasive pest threats to NC forests, namely, Asian longhorned beetle, emerald ash borer, redbay ambrosia beetle/laurel wilt disease, Asian gypsy moth, and walnut twig beetle/thousand cankers disease of black walnut. Information on basic identification techniques and pest biology was provided.

In addition to oral presentations, outreach efforts took advantage of relevant public events. NCDA&CS set up booths at the NC Museum of Natural Science’s “BugFest,” which is attended by over 30,000 people and the NC State Fair, attended by nearly one million. Outreach efforts at the NC State Fair were paired with those of the NC Forest Service and focused on the “Don’t Move Firewood” message. It is estimated that approximately 500 individuals were reached directly through presentations and public events.

As part of Farm Bill-funded outreach efforts, advertisements concerning invasive species have routinely been placed in Western NC magazine and Triangle Gardener. Advertisements consist of graphics created by the USDA APHIS HungryPests campaign.

Export: Disease certification requirements and pathogen distribution information

Most agricultural commodities exported to foreign countries and to some U.S. states must meet certain requirements with regard to plant pests. Countries and states differ as to what is perceived as a plant pest risk. The Plant Pathologist received and handled requests from Field Specialists for assistance with interpretation of plant disease and nematode certification requirements and determination of pathogen distribution.

Export: Tobacco blue mold – requirements for export of tobacco to China

If blue mold of tobacco occurs in a state's tobacco crop in a given year, that state must complete field surveys to detect the sexual spore stage (oospores) of the blue mold pathogen, *Peronospora tabacina*. If oospores are not detected in infected fields, the tobacco may still meet requirements for export to China. Survey procedures developed by USDA-APHIS-PPQ are required. The Plant Pathologist updates the NC survey procedures yearly and sends them to the NCSU Plant Pathology Tobacco Extension Specialist for distribution to NC Cooperative Extension Service county personnel in the event that blue mold occurs. NCCES county agents conduct the survey by collecting samples from affected counties and submitting them to an approved lab (i.e., the NCSU Plant Disease and Insect Clinic). Industry groups pay for sample assays.

Nematode certification

California has import requirements concerning reniform and burrowing nematodes. To assist nurseries that wish to send plants to California, Field Specialists collect soil samples and submit them to the NCDA&CS Nematode Assay lab according to procedures developed by the Plant Pathologist, who also provides oversight for this program. A sampling table based on numbers of plants or area sampled was developed by the Plant Pathologist. Using this table enables growers to pre-determine costs prior to sample collection and submission. [Note: Reniform and burrowing nematodes have not been found in any NC nursery. Reniform nematode was found in eight NC counties under agronomic field conditions, but burrowing nematode has never been found at any location.]

Permits: Movement of plant pathogens for research and other purposes

The USDA-APHIS-PPQ Form 526 ("Application and Permit to Move Live Plant Pests or Noxious Weeds") permits the movement of plant pathogens and other pests into NC for research, diagnostic identifications, or commercial uses. The Plant Pathologist has the responsibility of adding comments to address state-specific concerns regarding each application. USDA-APHIS-PPQ issues final approval or denial of each application. All plant pathogenic organisms are subject to this requirement. The risk associated with each organism is evaluated to ensure that adequate safeguards are listed in the conditions of the permits. During 2017, 86 permit applications were evaluated. Pathogenic species evaluated included approximately 551 fungi/oomycetes, 112 bacteria, 32 nematodes, and 2 viruses.

Tobacco Plant Inspections

The NC Tobacco Plant Certification Regulation requires anyone who moves tobacco plants into NC from another state to do so under an import permit system. There were no import permit applications received during this reporting period. Another aspect of the regulation requires that plants grown in NC and sold for planting in a location more than seventy-five (75) miles away from the place of production must be inspected and certified. A major reason for this requirement is to prevent the artificial movement of blue-mold or virus-infected plants from one growing region into another, which could initiate a premature disease epidemic. There were no certified tobacco plant nurseries during this reporting period.

Vegetable Plant Inspections

The Vegetable Plant Certification regulation requires weekly inspections and certification of vegetable plants grown in NC for sale to commercial growers. There were no vegetable plant nurseries certified under this regulation during this reporting period. The NC Crop Improvement Association (NCCIA) certifies a large number of sweet potato cuttings and “seed” under its certification program. Because NCCIA certification requirements meet or exceed the standards of the vegetable plant regulation, NCDA&CS accepts inspections and certification tags of NCCIA in lieu of its own.

Regulatory Weed Program Report

Program Objective

The North Carolina Regulatory Weed Program protects North Carolina agriculture, public health, and native plant ecosystems from the harmful impacts of noxious weeds. The regulation of noxious weeds is authorized by the North Carolina Plant Pest Law and the Aquatic Weed Control Act of 1991. Program activities include inspections, issuance of Phytosanitary Certificates, issuance of Scientific Permits for movement of regulated articles and the survey, control, and eradication of Federal and State listed noxious weeds. The Witchweed Eradication Project, funded by USDA, APHIS, PPQ, is also a vital part of the Regulatory Weed Program. In addition, the program manager recommends justified changes to the NC Administrative Code that are relevant to noxious weed listings and quarantine boundaries.

Program Accomplishment Highlights

Witchweed Eradication

- The Witchweed eradication program continues to make gains in released acres in spite of the discovery of new or re-infested fields. The total acreage of active fields (i.e. fields with fewer than 5 points) is now 1,266 acres in NC.
- There were 142 new or re-infested acres in 2017. This highlights the need for vigilant survey, and shows the excellent work ethic of the Plant Pest Inspectors who are currently working on the witchweed eradication program. Each of these fields were discovered as part of regular delimited surveys in infested counties.
- Survey of terminated fields in Pender county continued, in preparation for the eventual release of this county from the Witchweed quarantine. No infested fields were discovered as part of this delimited survey effort.
- 1,701 acres were treated in the quarantine area as part of the witchweed eradication program, using treatments of disking, ethylene, hand pulling, and herbicide application to control the germination and/or flowering of the weed.
- A total of 48,844 acres were surveyed during 2017 to evaluate the status of witchweed infestation in the 5 quarantine counties of NC.

Tropical Spiderwort

- The Wake county location of Tropical Spiderwort was discovered in June 2015. It was hand rogued, treated with fire, and then sprayed with herbicides in 2015. Two additional herbicide applications were made in July and September of 2016. Two additional herbicide applications were made in July and October of 2017. The population is diminishing, but will continue to be monitored.

Cogongrass

- Cogongrass (*Imperata cylindrica*) continues to be monitored in NC. There were 5 actively managed sites in NC from 2012 to 2017. However, in 2017 new reports of infestations in Pender, Sampson and Moore county were made. There are now 11 active sites of

Cogongrass being managed in North Carolina, with an objective of complete eradication. Over 100 people were reached in a series of 7 “roadside sessions” that were held at the sites of active infestation. These workshops were well received, and attended by State Agencies, as well as local DOT, Cooperative Extension and Forest Service Employees. Attendees were able to see the plant *in situ*, and learn about the history of invasion, life cycle, key identification characteristics, and treatment recommendations.

Other Noxious Weeds

- A retailer at the NCDA&CS Farmers Market was selling Crested Floating Heart (*Nymphoides cristata*) in June 2017. A stop sale notice was issued, and all plants were destroyed. Three individual nurseries were also inspected, but no plants were found there. A group of 8 Plant Pest Inspectors attended an Aquatic Plant Identification workshop that was organized by NCSU.
- One hundred sixty-three Tropical Soda Apple plants (*Solanum viarum*) were found during the 2017 survey at Faircloth Farms in Sampson County. This is a serious increase in plant material that is normally found at that farm. It was discovered that the plants had escaped from the original fields where cattle were allowed to graze, and into fields on the rest of the farm. As a result, four complete days were spent (200 hours) surveying almost the entire farm with arable fields (~7,000 acres). The plants were bagged and incinerated, and maps were made to document the location of the populations.
- Small broomrape (*Orobanche minor*) continues to be confined to only a few plants in several locations of Mitchell County. Annual surveys are necessary to find the plants and destroy them to prevent additional spread. A small infestation was discovered on May 23, 2012 at the Western NC Regional Livestock Center near Canton, NC. Over 2500 plants were hand-rogued from the site in 2016, and herbicides were applied to the host to further reduce populations. Only a few plants were found in 2017, and they were all dug out and destroyed.
- Purple loosestrife (*Lythrum salicaria*) is still confined to two general sites; Forsyth County and Henderson County. Annual surveys are necessary to find the plants and treat them with herbicide to prevent spread. The Henderson county site continues to spread, so an aggressive treatment plan was implemented in 2017.

Six sites are actively being managed for infestations of itchgrass (*Rottboellia cochinchinensis*) in Robeson County. A new site east of I-95 was discovered by Michelle Shooter (NCDA&CS) in 2014, and another new site was discovered in late 2015, and an additional two sites in 2016 surveys. Meetings between landowners has started a partnership between NCDA&CS, NC DOT, CSX and the growers to help combat this weed. A preemergence herbicide of prodiamine was applied in early spring to help with new plants. Glyphosate was applied POST during the summer and fall of 2017 to control emerged plants and escaped plants were hand-pulled and disposed of. Two temporary employees were dispatched to the sites once a week from July to November, and they made

- incredible progress with the weed. The morale of the farmers is high, which is key to the continuation of this project.
- Efforts continued to evaluate efficacy of weevil releases as a biocontrol agent for mile-a-minute vine (*Persicaria perfoliata*) in Alleghany, Gates, Perquimans and Yancey counties. Plants were collected in the wild, and propagated in secure growth chambers at the Bio Control Labs during the summer of 2016. These plants will be used in weevil feeding trials in 2017 and beyond.
- Giant hogweed (*Heracleum mantegazzianum*) is continuing to be monitored at 6 separate sites in Watauga County. Herbicide treatment and hand-pulling were both utilized to control these infestations in 2017, but plants were only found at two of the locations, and very low numbers.

Regulatory

- 104 phytosanitary certificates were issued to support the Witchweed (*Striga asiatica*) quarantine program. This number has decreased in recent years because of the issuance of Compliance Agreements with several cooperators.

Public Relations and Outreach

The Weed Specialist serves in an advisory role for a number of weed species in a number of workgroups and Technical Advisory Committees (TAC). Tasks related to these responsibilities include attending numerous meetings across the state and weighing in or reporting upon the status of weed control programs, writing weed management plans with other stakeholders in the TAC, coordinating outreach within the group, and weighing-in on budgetary concerns regarding the control programs. The groups are included in following list:

Committee or board member:

- North Carolina Aquatic Weed Council
- Eno River Hydrilla Technical Advisory Committee (Outreach Committee & Scientific Committee)
- Hydrilla in the Chowan Workgroup
- Lake Waccama Technical Advisory Group for Hydrilla Management
- Aquatic Nuisance Species Workgroup (Wrote an ANS Plan)
- Invasive Species Action Team – Albemarle Pamlico National Estuary Partnership
- White Lake Technical Advisory Committee for Hydrilla Management

The Weed Specialist is a member of the following Regional Weed Science Groups:

- North Carolina Weed Science Society
- North Carolina Invasive Plant Council (President)
- South Carolina Aquatic Plant Management Society
- Weed Science Society of America

Educational talks were given to the following groups of people:

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Date	Group	Location	Title of Talk	People Reached
March 23, 2017	Bioenergy Research Initiative	State Fair Grounds, Raleigh	Invasive Risk Modeling and Voluntary BMP's for Energy Crops	50
May 4, 2017	NC Lake Management Society	Alamance Community College	EddMapS & SEEDN: Apps to Identify and report invasive plants.	50
May 06, 2017	Pond Clinic - Durham/Orange Soil & Water Conservation	Blackwood Farm Park, Hillsborough	Update on Hydrilla in the Eno River	25
June 6th 2017	Plant Pest Inspectors	Method Rd Greenhouse	Aquatic Weed Identification	10
July 10, 2017	Forest Service	Pender County (Wallace)	Cogongrass Identification and Status in NC	20
August 14, 2017	DOT, Extension,	Pender Co. (Halfway Branch School Rd).	Cogongrass Identification and Status in NC	30
August 25th, 2017	Master Gardeners Pender County	Pender Co. (Halfway Branch School Rd).	Cogongrass Identification and Status in NC	10
September 15, 2017	DOT, Forest Service, Land Conservancy, USFW	Sampson Co. (Wildcat Rd, Ivanhoe)	Cogongrass Identification and Status in NC	30
September 29, 2017	Henderson County Master Gardeners	Airport, Hendersonville	Purple Loosestrife, Cogongrass ID	10
October 12th, 2017	NCDA Plant Pest Inspectors	Pender Co. (Shiloh Rd)	Cogongrass Identification and Status in NC	10
October 17th, 2017	NC Soil & Water Conservation Region 6 Meeting	Duplin Ag Center, Kenansville	Cogongrass Identification and Status in NC	100
October 23, 2017	Pender County Livestock Producers	Pender Co. Extension Office, Burgaw	Cogongrass, Tropical Soda Apple & Other Invasive Weeds	15
October 24, 2017	Central Region Plant Pest Inspectors	Sandhills Community College	Cogongrass Identification and Status in NC	10

The Weed Specialist gave the following talks at Research and Education Meetings:

Date	Group	Location	Title of Talk	People Reached
January 18th - 20th 2017	South Carolina Aquatic Plant Management Society (SCAPMS)	Myrtle Beach, SC	<i>Philydrum lanuginosum</i> , a new invasive weed find in North Carolina	75
March 10th 2017	North Carolina Invasive Plant Council	Elon University, Elon NC	Wooly Frogsmouth: A new aquatic Invasive Species Found in North Carolina.	65
May 11th 2017	Gulf and South Atlantic Regional Panel on Aquatic Invasive Species (GSARP)	Savannah, SC	Wooly Frogsmouth found in Pender County, NC; a first find of this invasive plant in the U.S.	50
October 4 th - 6th 2107	South Carolina Aquatic Plant Management Society (SCAPMS)	Myrtle Beach, SC	An Update on Wooly Frogsmouth in North Carolina, South Carolina & Florida	75
December 7th, 2017	North Carolina Vegetation Management Association (NCVMA)	Greensboro, NC	Cogongrass: A new threat to Rights-of-Ways in Eastern NC.	100

Guest Lectures were given in the following classes:

Date	Group	Location	Title of Talk	People Reached	Contact Person
January 26, 2107	CS 415 - IPM Course	NCSU - Raleigh, NC	Invasive Weed Program and Regulatory Issues in NC	50	Dr. David Jordan

The Weed Specialist wrote or contributed to the following publications:

Date	Group	Activity	Title of Publication	Publication Type
Spring 2017	NC Vegetation Management	Co-Author	Aquatic Plant Found in Pender County -First find of this invasive in the US	Newsletter Article
Fall 2017	NC Vegetation Management	Co-Author	The Hunt for A Wanted Weed, Cogongrass	Newsletter Article

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September 2017	Woodland Owner Notes E-newsletter	Co-Author	Cogongrass, Even Worse than Kudzu	Newsletter Article
September 27, 2017	Alleghany News	Contributed	Fast Growing Weed in County; Much of western Alleghany quarantined for mile-a-minute vine.	Newspaper Article

Other Outreach Efforts:

- The Weed Specialist cooperated with employees from the NCDA Plant Industry Division, the NC Department of Transportation, NC Cooperative Extension, and the NC Forest Service to organize several “roadside educational sessions” when Cogongrass infestations were found in Pender, Sampson and Moore counties during the summer and fall of 2017. Based on sign-in sheets that were sent around at each of the meetings, approximately 100 individuals were reached through these outreach sessions. Attendees included various State and County agencies, local farmers, members of Land Conservancies, USFWS, and company representatives. Topics included plant identification, a history of invasion, possible methods of dispersal, sanitation of equipment, and control options.
- The weed specialist and an employee of the Aquatic Weed Control Program sent letters to homeowners in the Upper Eno River Watershed to ask for permission to scout their farm ponds for the presence of hydrilla. Two days were spent scouting 20 different ponds to ascertain presence or absence of hydrilla. The results were added to the results from scouting efforts in 2016, and published in color maps of the area.
- Numerous weed-related web pages were updated and placed on the Division Website. Fact sheets were created and printed for several invasive weeds, including Floating Heart, Woolly Frogmouth, Cogongrass and Purple Loosestrife so that they are available for outreach efforts.
- An “Itchgrass Town hall” meeting was held in Robeson County in Feb 2017. Approximately 20 people attended (farmers, DOT employees, Cooperative Extension, NCDA&CS) the workshop to discuss distribution, control efforts and status of the control program.
- The Weed Specialist continued to serve as the official verifier for invasive plant reports in North Carolina and posted to the EDDMaps website by the general public.
- The Weed Specialist provided assistance to Mr. Sam Brake to select the Grantees for the Bioenergy Research Initiative Program in November of 2017.

- On several occasions assistance was provided to outside individuals who requested images of invasive weeds for publications and signage.
- On numerous occasions, assistance was provided to help identify weeds and provide weed control recommendations in crop, turf, aquatic and non-crop sites.
- On numerous occasions, assistance was provided to recommend control methods for a particular weed problem for a citizen or farmer who requests assistance.

Additional Certifications

The Weed Specialist completed the OSHA 10-Hour course in November 2017, and First Aid, CPR and AED training in December of 2017. Both of these training sessions will aid the weed specialist in her supervisory and safety responsibilities within the Witchweed Eradication Program.

Aquatic Dealer Inspections

Aquatic dealer inspections are completed each year by the Plant Protection Specialists. In 2016, the database organizing these inspections was revised. A new database was rolled out to the Plant Pest Inspectors in 2017 with over 400 locations that needed to be inspected. Many of the locations no longer sold aquatic plants. By the end of the inspection period, at least 120 retailers were inspected for aquatic plants.

General Weed Survey and Eradication Program Details

Survey Methodology and Rationale: Surveys for all projects were done by visual reconnaissance. Survey objectives are: 1) identify new infestations of target noxious weed (i.e. detection surveys); and, 2) delimit the boundaries where the weeds were mapped in previous years (i.e. delimiting surveys). Detection survey location targets were selected based on probability that subject plant pest would be present. In some instances, GPS coordinates were recorded to provide reference points for mapping and relocation, if needed.

Roadsides close to wet areas and home landscapes were targets for Purple loosestrife detection surveys. Locations known to have been infested with small broomrape (*Orobanche minor*) in the past were checked several times during the summer for reoccurrence of the weed. Also, past known locations for itchgrass (*Rottboellia cochinchinensis*) were surveyed in June through October to monitor results of pre-emergent herbicide treatments applied in February 2017, and to ascertain new infestations. Cattle slaughter houses and holding farms in Sampson county are surveyed twice annually for infestations of tropical soda apple.

Since plant species must be identified during the growing season, all surveys are done during the period from full leaf (June) through the first hard freeze (usually mid-November).

RESULTS OF ACTIVE WEED CONTROL PROGRAMS

Broomrape (*Orobanche minor*)

Orobanche minor was discovered by Rebecca Norris and Kathy Kidd at the Western North Carolina Livestock Center near Canton, NC (Haywood County) in 2012. The infested area was burned with propane torches in 2012 to kill surface seed. The site was monitored during 2014 by Tim Hartley and James Corbin and treated as needed with a broadleaf herbicide to eliminate clover, which is a host plant of *Orobanche minor*. Approximately 15 plants were removed by hand in 2014, in a location measuring 5ft X 5ft. In 2015, Tim Hartley and James Corbin checked the site twice in May and found 120 new plants slightly uphill from the infestation in 2014. They were all removed by hand. In June 2015, about 325 plants were dug out by hand in an area of 5ft x 5ft. Repeated checks during the rest of 2015 revealed no new plants. In May of 2016 over 2,500 individual orobanche plants were dug out of the site, just slightly uphill from the original infestation. On May 16th of 2016, the site was treated with herbicide to kill the host plant (clover). The site was treated several times in May and June of 2017 to remove additional plants. Close monitoring of the site will continue until the plants are no longer found for several years.

A second site, a hay field in Mitchell County is also regularly checked. No new plants were discovered in 2015, 2016 or 2017.

Chinese Water Spinach (*Ipomoea aquatica*)

Cooperation between the APHIS-PPQ inspector and the plant pest inspectors from NCDA&CS has continued in 2016. Compliance agreements were completed for 10 Asian markets who are known to be selling Chinese water lettuce in Durham, Guilford, Mecklenburg, New Hanover, and Wake counties. In late summer of 2015 it was decided to discontinue these agreements due to the risk associated with importing Sweet Potato Weevil (of which, *Ipomoea aquatica* is a host plant) if the plant was grown in a state other than NC. Therefore, there are only 3 remaining active compliance agreements between NCDA&CS, and those are for NC growers of *Ipomoea aquatica*.

Cogongrass (*Imperata cylindrica*)

Cogongrass is considered a serious invader due to its ability to establish on a variety of soils and sites and ability to change ecosystem function by creating conditions for more frequent and hotter fires. It is a Federal and State of NC Noxious Weed that continues to invade thousands of acres across the Southeastern U.S. The first NC infestation was discovered in 2012 in Pender County. Roughly one site a year were discovered, until the summer of 2017, when 6 new sites were discovered in Pender, Sampson and Moore Counties. One of these sites was the first Pender County site discovered back in 2012. The landowner had been keeping the site mowed, so that none of the cogongrass could be seen. In the summer of 2017, the landowner was recovering from an injury, and was not able to mow the site in a timely manner.

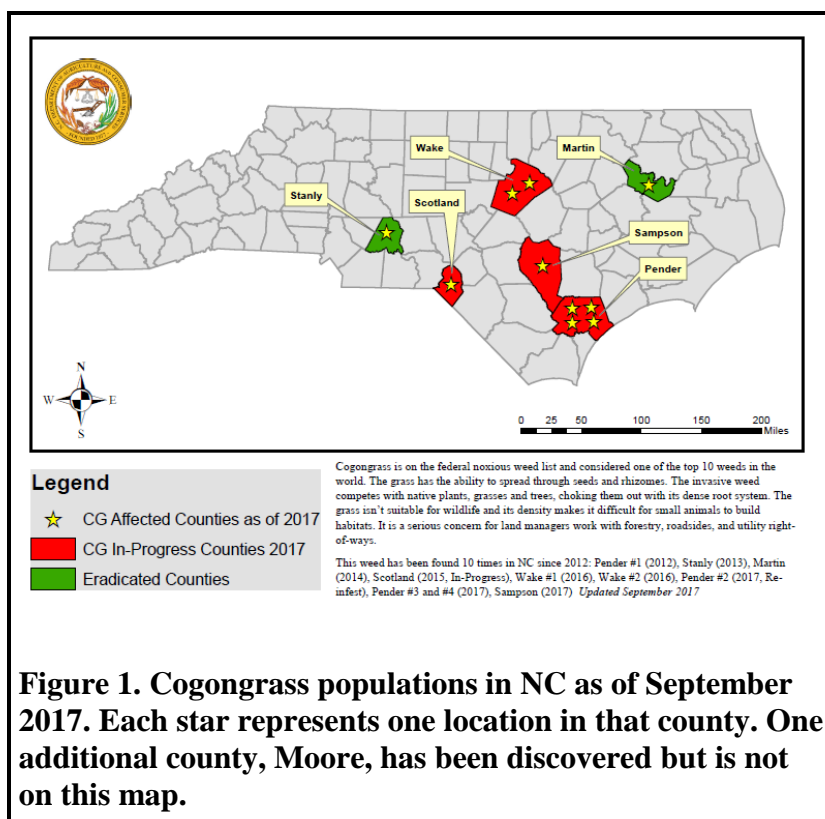


Figure 2. NCDA&CS Staff apply herbicide to a Cogongrass quarantine site in Pender Co. July 10, 2017.

There are a total of 11 cogongrass sites (both active and eradicated) now known in NC. Some of the sites were discovered by NCDA&CS Plant Pest Inspectors, and one site was discovered through a series of 250 outreach letters sent to Master Gardeners, Community Gardens and Arboreta. Many people responded to the mailing effort, and one positive location was obtained from the effort. An updated map of the current Cogongrass infestations in NC can be found in Figure 1.

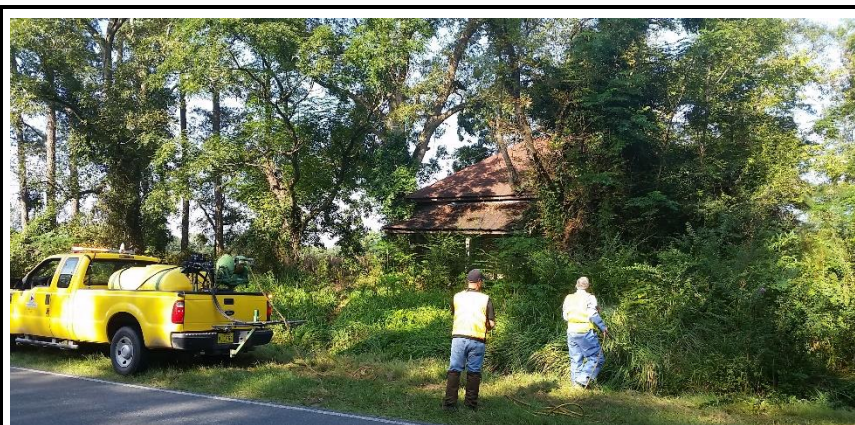


Figure 3. Employees of the NC DOT assisted in spraying a roadside infestation of Cogongrass located in Sampson Co., September 2017.

After obtaining permission from each landowner, the new cogongrass sites were treated with an herbicide treatment of 2% Imazapyr plus glyphosate during the Fall of 2017. Some of the treatments were made by the NCDA&CS, and other sites were treated by the NC DOT. One site, has not been treated. It is located on a right-of-way owned by a power company, and a treatment plan has not been

discussed. Some of the sites are suitable for winter burning to remove biomass and thatch, and the NC Forest Service will be consulted about the feasibility of this activity during the winter and spring of 2018.

A total of seven “roadside training sessions” were held during the summer and fall of 2017. Over 100 people were reached through these training sessions, and the attendees were given the chance to see the plant ‘in situ’, discussed identification features, possible pathways of introduction, modes of eradication, and other topics pertinent to the weed. Attendees came from the NC DOT, Master Gardeners, Cooperative Extension, NCDA&CS Employees, NC Coastal Land Trust, USFW, and NC Forest Service.



Figure 4. NCDA&CS Plant Pest Specialists and NC Cooperative Extension Agent, Minda Daughtry, view Red Baron Cogongrass in Moore Co., October 2017.

Crested Floating Heart (*Nymphoides cristata*) Yellow Floating Heart (*Nymphoides peltata*) & Water Snowflake (*Nymphoides indica*)

Crested floating heart is established in south Florida, and was first discovered in Lake Marion, in the South Carolina Coastal Plain, in 2006. It has proven to be extremely difficult to manage in both states. Three floating heart species [Crested Floating Heart, water snowflake (*N. indica*) and Yellow Floating Heart (*N. peltata*)] were placed on the NC state noxious weed list in 2012.

Crested floating heart was first discovered in North Carolina in May of 2014 in a private pond in Guilford County. Hydrothall 191 was applied by NCSU field staff each year from 2014 to 2017. The infestation has been reduced by 98%, and Andrew Allen will continue to monitor the site in 2018.

New Bern Site: Yellow floating heart was discovered growing in a 3-acre pond located on a golf course in New Bern in the Fall of 2015. David Pearce and the Weed Specialist worked with the homeowner's association to create an eradication plan for the pond in 2016. Herbicide treatments began in May 2016. A total of 4 herbicide sprays were applied to the entire lake during the year in cooperation with NCSU Crop Science department, and the DEQ Aquatic Weed Control Program. Herbicides that were used include Aquathol K, and Imazapyr. The infestation was reduced by at least 50% in the first year. Herbicide treatments continued into the 2017 year, and the treatments have further reduced the infestation to about 25% of what it was two years ago. Herbicide treatments will continue in 2018 in cooperation with NCDA&CS and the DEQ Aquatic Weed Control Program



Figure 5. April Bauder, NCDA&CS, applies herbicide to Yellow Floating Heart in Hillsborough, NC on June 13, 2017.

Hillsborough Site: Yellow floating heart was reported to the Weed Specialist in February 2017 at a meeting by a private herbicide contractor. It is located on a private residence, in 3 separate but connected ponds. The site is less than a mile from the Eno River. A private company, SePro, collaborated with NCSU and NCDA&CS employees to devise a treatment plan for the site. Three different herbicides were applied on June 13th. Most were very effective, and provided almost

100% control in one of the ponds (the largest). Subsequent herbicide treatments will be discussed with the homeowner as needed.

Crested Floating Heart was discovered being sold at the NCDA&CS State Farmers Market in Raleigh in June of 2017. The seller was notified that it was a state noxious weed, and a Stop Sale notice was issued. All plants at the retail establishment were destroyed, as well as the plants located at their nursery. Two other nurseries were also inspected and found not to be growing any *Nymphoides* species. Mike Massey also discovered a *Nymphoides* species being grown in another retail nursery establishment during the summer of 2017, and those plants were also destroyed under a Stop Sale notice.

Giant Hogweed (*Heracleum mantegazzianum*)

Giant Hogweed is a concern in NC because it is a dermal sensitizer – meaning that exposure to the sap causes a skin reaction known as photodermatitis that results in large painful blisters. The plants were first officially reported in the state in 2011. Many people call the NCDA&CS weed specialist each year to report findings of this plant, but so far they have all turned out to be the native species, Cow Parsnip.



Figure 6. Crested Floating Heart plants removed from a nursery, June 2017.

There are six sites (Table 1) in Watauga County where Giant Hogweed has been located, and is being managed by Chad Taylor. Each site is visited periodically, and treated when needed. The following list of sites (and accompanying GPS coordinates) describe the number of plants counted and treatment if it was needed for 2017. All plants are treated with a 3% solution of glyphosate.

Table 1. Known sites of Giant Hogweed Infestations in Watauga County, NC.			
Site	GPS Coordinates	Location	# Plants in 2017
1	36.15037, -81.66012	Skiing Visitor Station	0
2	36.13680, -81.67685	Birch Drive House in Blowing Rock.	0
3	36.12144, -81.74338	Hillside. Planted for soil stabilization	0
4	36.11989, -81.74354	Housing Development	0
5	36.11446, -81.77836	Green Mt. Creek Waterfall	4
6	36.1394825, -81.6918097	Bass Lake	1

Giant Salvinia (*Salvinia molesta*)

Giant Salvinia, a Federal Noxious Weed, was detected at an aquatic nursery display at the North Carolina State Fair in 1998, and subsequent surveys by NCDA&CS, NCDENR, and NCSU personnel resulted in detections in 26 counties in North Carolina. All of these infestations have been eradicated, however, in September 2000, naturalized infestations of Giant Salvinia were detected in golf course ponds in New Hanover County and in a canal and wetland at the Riverbend near Burgaw in Pender County. Acting under the authority of the Aquatic Weed Control Act of 1991, NCDENR Water Resources personnel began herbicide treatments at these sites in November, 2000. A survey of the Northeast Cape Fear River and adjacent wetlands at the Pender County site in 2005 and 2007 yielded no new finds of Giant Salvinia. Survey and monitoring of the River Bend site in Pender County has continued to the present.

The current status of Giant Salvinia in NC is that there are no known populations in North Carolina, however there has been a new discovery of the plant (measuring 100 acres) in the Santee Cooper watershed. This lake is located only 100 miles from the NC border, and the threat of spread is high. Herbicide treatments have started, but eradication will take several years.

Former members of the Giant Salvinia Task Force were consulted during the summer of 2017 for more information on former infested sites in NC. A relatively complete list of locations has been put together, and several of the sites will be visited in 2018 to make sure that they are still free of Giant Salvinia. The most infested site, River Bend, was visited by the Weed Specialist in October 2017. It is still free of Giant Salvinia, but the swamp has far less water in it than when it was infested in 2006.

Hydrilla (*Hydrilla verticillata*)

Lake Waccama: Hydrilla was found in Lake Waccama in 2012. An estimated 698 acres were infested. There are 28 rare species in the lake – including 11 mollusks, 4 fish and 13 other plants, making treatment efforts complex. Multiple state agencies banded together to form a Technical Advisory Committee (of which the weed specialist is a member) to design a treatment plan. They put out herbicide treatments on the lake in 2014 at an estimated cost of \$486,000. Herbicide treatments were applied in 2014, 2015, 2016 and 2017. The treatments have been very successful at controlling the existing vegetation and hopefully reducing the tuber bank in the soil. Treatments will continue in 2018, however the TAC decided to decrease the treatment area from 960 acres to 600 acres.

The weed specialist assisted the NCSU Aquatics group in July of 2017 in taking 200 soil core sediment samples from the lake to ascertain the number of hydrilla tubers in the lake. No tubers were found in the course of the day, and only two tubers were found in more than 1,000 soil samples. This indicates that the hydrilla is successfully being eradicated from the lake.

Eno River: A technical committee was formed in 2013 to form a strategy for managing the Eno hydrilla infestation, and the State Weed Specialist is a member of that committee. It is estimated that \$50,000 will be needed each year for several years.

Hydrilla is completely infesting all sections of the river in Eno River State Park. Seven funding partners were identified by the Eno River Hydrilla Management Task Force, and each partner contributes money to the effort. The contract is approximately \$60,000 a year.

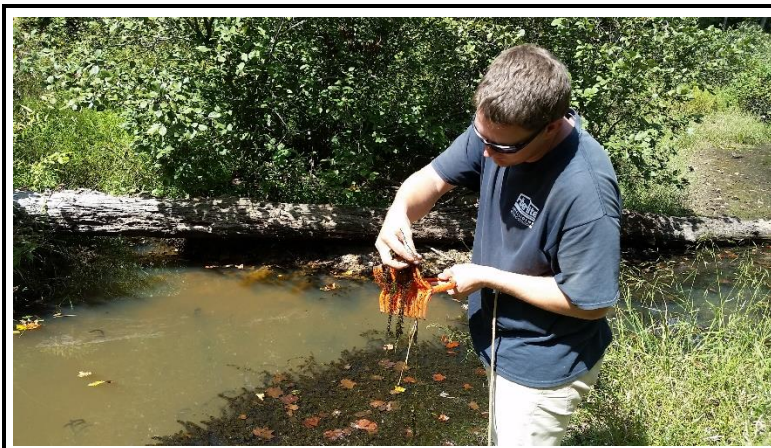


Figure 7. Andrew Gay, NCDEQ, examines hydrilla from a rake-toss in a farm pond in the Eno River Watershed, September 2017.

The second year of a two-year pilot study was completed in 2016, with 17 miles of the Eno River being treated with herbicide. The herbicide is applied using a two separate drip type applicators installed on the river through a contract with SePRO Company. The treatments were highly successful in 2016, and did a good job at controlling the hydrilla. The treatment area was increased in 2017, and encompassed about 21 miles of the river. Treatment plans

continue to target an even bigger area for 2018.

In addition to the main stem of the Eno River, farm ponds in the Upper Eno River watershed were surveyed for the presence or absence of hydrilla in an effort to understand the scope of the hydrilla problem, as well as the possible source of the infestation. Using aerial maps, ponds were identified and homeowners were found and contacted about the project. In 2016, 30 individual ponds were surveyed for the presence of hydrilla. Nearly 1/3 of the ponds (9 total) were positively confirmed for the presence of hydrilla. An additional 20 ponds were surveyed during the Fall of 2017. Only one location was

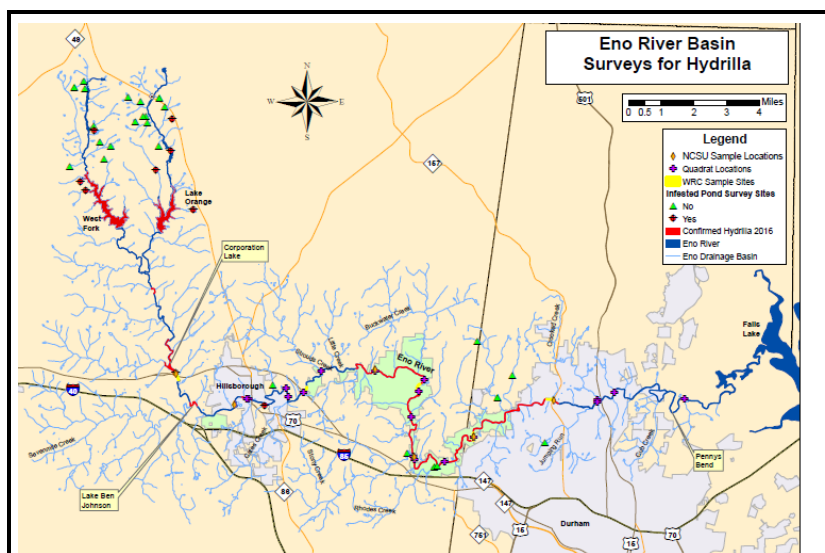


Figure 8. Color maps created for the Eno River Hydrilla Project by Justin Karl. Areas in Red were positive for Hydrilla.

found to be positive for hydrilla. Color maps of the ponds were created, and used for outreach efforts.

Itchgrass (*Rottboellia cochinchinensis*)

Itchgrass is a federal noxious weed, and poses problems because when touched because it can cause contact dermatitis to the skin. Efforts to control this weed in Robeson County have been ongoing since 1983. It was thought that the weed was eradicated in 1988, however it was detected again in the late 2000's. There are now 5 separate areas located around the town of Rowland, NC that are known to be infested with this weed (Table 2).



Figure 9. NCDOT employee Randy Raynor spraying Prodiamine herbicide on the Chicken Road Itchgrass site, March 2016.

A “town-hall” meeting was held in 2016 and has created a strong partnership between NCDA&CS, NC DOT, CSX and the growers to help combat this weed. Five roadside itchgrass sites were treated with a PRE application of prodiamine herbicide in February of 2017. Good control was achieved at all sites. The NC DOT also posted “Do Not Mow or Spray” roadside signs at each of the 5 sites to encourage DOT contractors and farmers to avoid the areas. Seeds are likely moved around through equipment, and contract mowers are thought

to have contaminated the Williams Pond Road Site in 2013.

Table 2. Known Itchgrass sites located in Rowland, NC. Robeson County. 2017.

Site #	Location Name	Year Discovered	Miles of Roadside to be Treated
1 (a)	Chicken Rd	2014	2.0
1 (b)	Dew Rd (End of Chicken Rd)	2015	0.6
2	Blue Pate Rd & US Hwy 301	1985, 2011	0.2
3 (a)	Williams Pond Rd	2014	4
3 (b)	Browns Farm Rd	2014	0.3
3 (c)	Cotton Valley Rd	2014	1.6
3 (d)	Echo Rd	2015	2.2
4	Hwy 501	2011	0.2
5	Iona Church Rd	Sept 2016	0.1

Post

emergence glyphosate applications were made by the NC DOT, Michelle Shooter and local farmer, Kay McGirt, throughout the growing season. In addition, two NCDA&CS temporary employees

worked the area during the growing season. These employees scouted fields in known areas of infestation, and sprayed when necessary with glyphosate to control emerged plants. A large amount of headway was made in the eradication program through these efforts in 2017.

All of the known Itchgrass sites have been condensed into colorful maps using Arc GIS, and the maps have been posted to the Plant Industry website. Letters about the project were sent to landowners in the area so that they would understand the control measures that were being enacted in order to try and contain the weed. A public farmer meeting will be held in 2017, and Cooperation between DOT, NCDA&CS and Robeson Co. farmers is ongoing to detect and control infestations of itchgrass.



Figure 5. NCDOT signs posted at each Itchgrass site encouraging landowners not to spray or mow the sites.

Mile-a-minute vine (*Persicaria perfoliata*)

Mile-a-minute (MAM) vine is documented in the following NC counties NC: Alleghany, Gates, Guilford, Pasquotank, Perquimans, Rockingham, Watauga and Yancey counties. The original population was found along the Mayo River in Mayo River State Park (Rockingham County).

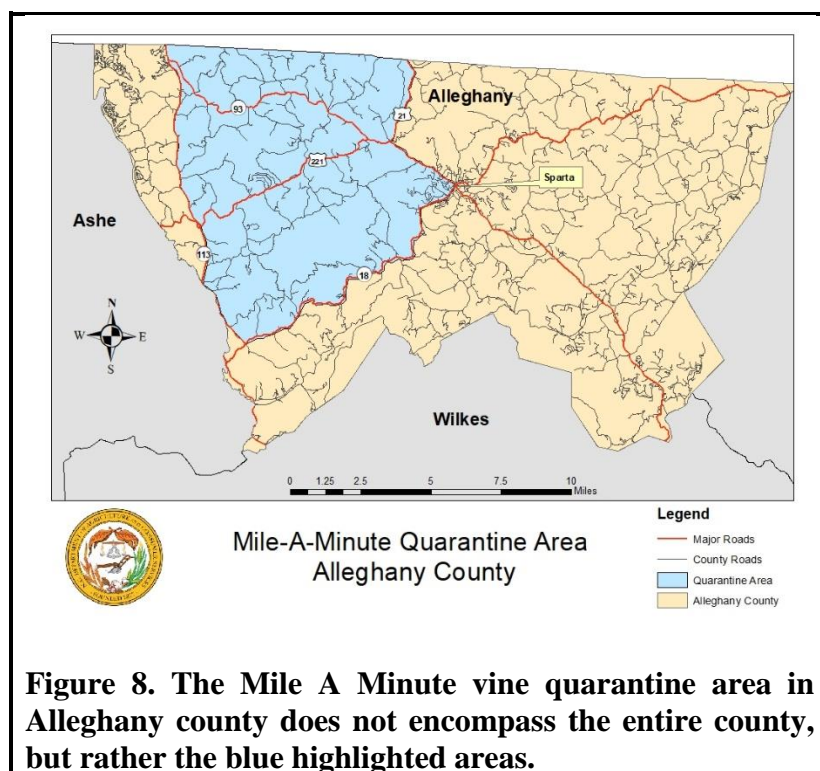
Since 2011, biological control of MAM weed has been underway in NC under the supervision of Dr. Kathy Kidd (former biological control administrator, NCDA&CS) and now Dr. Steven Turner. In May



Figure 7. Dr. Steven Turner releases Mile-a-minute weevils in a patch of Mile a-minute vines in Pasquotank County, June 2017.

In May 2017, MAM weevils obtained from the New Jersey Department of Agriculture were released in Gates and Perquimans counties in an area where they were also released in 2014, 2015 and 2016. Existing populations of the weevils were noted, showing that the populations have become established in those areas. New weevil populations were released where there were no signs of feeding. In July the MAM sites were visited in Rockingham and Guilford Counties. In August additional MAM weevils were released in Alleghany County. Extensive surveying of existing sites was done, and several additional sites were located. The general consensus is that the weevils are going a good job of reducing leaf area on the MAM plant, but the MAM plant is also growing in more sites than ever.

As a result of these observations the Weed Specialist and Dr. Turner decided to commence research to document feeding patterns of the weevils in North Carolina in order to determine if environmental factors were to blame for the differences in feeding patterns from New Jersey and North Carolina. Plants were obtained from the wild, transported to the BioLab in Cary, NC and propagated in growth chambers. A good amount of trial and error were involved in succeeding in propagating the plant, but a successful protocol was finally developed. It is hoped that the trials can begin in 2018.



A newspaper article about MAM vine was written in the Allegheny News on September 27, 2017 “Fast-growing weed in County” in an effort to raise awareness of the weed and its spread throughout the county. Several homeowners called to report the weed, and Chad Taylor visited their sites, but none of the sites were infested with MAM. Several known sites were visited in 2017, and an increase in the population of MAM vine was noted. Weevils were released there in an effort to reduce the seed-set for the year. It was determined that herbicide sprays may be needed to aid in the control effort in

those counties.

Oriental bittersweet (*Celastrus orbiculatus*)

Farmers markets in Asheville, Greensboro and Raleigh were inspected for Oriental Bittersweet in 2017, but no sellers were found to be selling the plant. The Raleigh Farmers market manager did find a vendor selling bittersweet wreaths in the Fall of 2017, and she insisted that the wreathes be destroyed.

One additional site of bittersweet was discovered in Raleigh in December of 2017. This find has prompted a re-evaluation of the quarantine area. A larger survey is planned for 2018 with NC Forest Service and NC Parks partners.



Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a federal noxious weed. It is prevalent in riparian areas, and displaces native vegetation. It has an attractive purple flower, and was thought to have been intentionally planted in NC. Eradication efforts have been ongoing for almost 20 years. There are two main areas that are in the process of being eradicated.

Site 1 – Guilford County: Sixteen sites are located near Winston/Salem. The first three sites below are the most heavily infested, but eradication efforts have greatly reduced the number of plants present in 2016. Site 5 (Oak Grove Church Rd) is likely to be the original site, and there have been no plants there for 4 years. Site 16, a golf course, is managed by the golf course personnel and monitored by Andrew Allen. Plants were surveyed and treated on three dates in 2016 (May, July and September) (Table 3). The flower heads were clipped and placed in garbage bags for incineration, and the remaining plants were treated with a 1.5% solution of Element 3A (triclopyr). The sites will continue to be monitored in 2017, with herbicide treatments made as necessary.

Table 3. Purple loosestrife sites and acreages treated near Winston-Salem, NC.

				Treatment Dates	
Site	Latitude	Longitude	Acres	June 2017	July 2017
				-----Plants Found -----	
I-40 West	36.07042893	-80.15678182	4.51	100	75
Rec Center	36.07213056	-80.15496865	2.03	0	0
Substation	36.07111048	-80.15596175	7.66	10	12
Farmingdale	36.08209177	-80.15750794	1.71		
Oak Grove Church Rd	36.08275462	-80.1357344	0		
Megahertz	36.05817098	-80.17106929	1.97	10	7
Krispy Kreme	36.0562938	-80.17078946	0.79		

Corning Plant	36.05567246	-80.17498931	2.05	8	3
Goose Pond	36.0535053	-80.18703683	7.83	10	1
Chaucer Lane	36.05043841	-80.18960097	3.82	1	2
Fox Meadow	36.0357447	-80.19275031	1.75	1	2
Villas	36.04122216	-80.20579241	0.57	0	0
1-40 East	36.0686042	-80.1563407	1.46	4	4
Wallburg	35.9975458,	-80.0930742	2.23	0	0
Little White Church	36.04627997	-80.19543131	0.85	0	0
Willshire Golf Course	36.017487	-80.259329	3.32	0	0

Site 2 - Henderson County: Purple loosestrife was also discovered in 2011 in Henderson County, and is being monitored by Sue Dial of NCDA&CS. 5 separate sites are being treated (Table 4) around the Henderson County airport. The site was discovered by a stewardship biologist with the NC Wildlife Resources Commission. The second site (across the road from the airport) encompasses 20 acres; which includes two soybean fields, an alley between the fields, and the City of Hendersonville sewer line right-of-way.

Table 4. Purple loosestrife sites and acreages treated in Henderson County, NC.				
		Treatment Dates		
Site	Acres	June 2017		September 2017
--- Status Report ---				
Airport (ditches)	1	less plants		Less plants
Large Soybean Field	8-10	large plants along both edges		Large plants
Small soybean field	2-3	Less plants along long edges, but majority located along north edge.		Many large plants in woods.
Home on Beverly Rd	>1	None		
Sewer Alley	>1	Few Plants		
Roadside	>1	Many Large Plants. DOT placed “Do Not Mow” Signs		

Herbicide treatments at the sites are ongoing. A complete survey of the site was conducted in 2017, and a more aggressive treatment plan was made. The highlights of that plan are that we visited the site 3 times a year instead of 2, and we switched active ingredients of the herbicide to imazapyr instead of glyphosate.

Tropical Soda Apple (*Solanum viarum*)

Tropical Soda Apple is a concern because the plants are large and spiny. Cattle prefer to eat the fruits, and thus the seeds are spread wherever cattle are moved in from areas where this weed is common (i.e. Florida). It has been managed for several years at two sites in NC, under the supervision of Herbie Ward and now Jensen McLamb.

Spot surveys were completed by Bridget in July of 2017, and very few plants were found. A thorough survey was completed using ATV's in October 2017 at both Faircloth Farm, and it was discovered that the infestation had moved to pastures on the farm where NCDA&CS had not been surveying. This commenced an aggressive survey and destroy effort on the farm, which measures 7,000 acres in size. Four



Figure 10. NCDA&CS Staff find ONE Tropical Soda Apple Plant in Sampson Co., October 2017.

full days were spent surveying every pasture on the farm, and at least 177 plants were found and destroyed. Some of the plants were the size of an ATV, and the bags filled the back of two pickup-trucks on the busiest day. A total of 200 man and woman-hours were spent on this project.



Figure 11. ONE mature Tropical Soda Apple Plant measures nearly as big as an ATV in Sampson Co., October 2017. Notice the ripe fruits, eaten by cattle, that hold 100's of viable seed.

No plants were found at Martin Meats. The plants found at the Faircloth Farm ranged from small (6 inches) to large (24 inches). Some large plants did have unripe fruit on them. All plants were pulled and disposed of in paper yard waste bags and incinerated.

Table 5. Tropical Soda Apple Survey Sites, Sampson County, NC.				
Date	Location	Acres	Fields	Plants Found
September 2017	Martin Meats	10	1	0
September 2017	Faircloth Farm	200	5	46
October 25 th , 2017	Faircloth Farm	1,000	26	91
October 30th 2017	Faircloth Farm	1,000	8	24
November 6 th , 2017	Faircloth Farm	1,500	10	0
November 16 th , 2017	Faircloth Farm	1,500	10	38
Totals				177

Survey efforts at both of these sites will continue in 2018, and the Faircloth Farm will be surveyed more often throughout the summer. An aggressive treatment plan has been devised, and outreach efforts to local cattle producers has also started.



Figure 12. Hard-working NCDACS Staff scouting Tropical Soda Apple in Sampson Co., October 2017.

Tropical Spiderwort (*Commelina benghalensis*)

Tropical Spiderwort is a federal noxious weed, and has several methods of reproduction, including underground flowers and tubers. Propagation of this plant can occur from stem cuttings, seed or tubers. Several locations of the plant have been found in NC since 2001, but the quarantine area is currently confined to two locations in Wayne County, NC. The quarantine for Tropical Spiderwort

remains active at the Cherry Research Farm near Goldsboro (Site 1). An additional quarantine was established at Claridge State Nursery in Goldsboro NC in August 2015 (Site 2). A third site (Site 3) was discovered in Raleigh and is under treatment for eradication.

Site 1: Cherry Research Farm: Tropical Spiderwort was found in a new field (Field 13) in September 2014, not located within the Farming Systems Unit. That field was fumigated in November 2015, and was monitored by Ann Gallagher until November 2016, when it was released to be planted to crops again.

Richard Banner of NCSU continues to monitor the infested crops located inside of the Farming Systems Unit. As of August 2017, he had found and destroyed 5 plants total on the farm during the year. Hurricane Mathew came into the region in October of 2016, and flooded that farm. Richard completed some survey of the farm to try and ascertain if any TSW seed had migrated during the flood, but found no evidence to that effect.

When equipment is sold, or moved off of Cherry Farms, it needs to be washed and inspected prior to transport to ensure that no propagules of TSW remain on the equipment. The following fumigations (Table 6) and inspections were performed by Ann Gallagher in 2017.

Table 6. Equipment Fumigations and Inspections at Cherry Farms, 2017	
Fumigations:	Inspections:
4/12 – Excavator (going back to Lake Wheeler Road)/Disc (given to University of Mt. Olive)	1/03 - John Deere 6120 R Tractor (for Governors' Inauguration) 3/02 – KMC Strip Tiller (going to Clayton RS) 3-13 – John Deere 6155 R (going to Raleigh for Ag Awareness Day) 4/05 – Excavator (to be fumed) 4/06 – Visit Cunningham RS; inspect Bedder/Plastic Layer 5/01 – Check on flooding/damages 5/16 – Bedder/2 Plastic Layers 5/18 – Test Plot Combine 5/23 – Veris & Gator on Trailer 6/14 – Test Plot Combine 7/18 – Case 395 & Ford 4630 (to go from dairy to Clayton RS) 8/16 – Hay Bale Roller 10/27 – Hege Cone Drill (Chris Reberg-Horton) & Hege Cone Drill/John Deere 950 Tractor (Dr. Murphy) 11/02 – Hege Planter/John Deere 4600 Tractor & Honda 300 4-Wheeler w/Spray Tank 11/09 – Hege 1000 Planter 11/29 – Weigh Cart

Cherry Research Farm Visitor Logs: All visitors to the Cherry Research Station are asked to sign in at the office, and the Station keeps a log of visits to the wash station. Ann Gallagher reported the following visits to the Wash Station in 2017.

Table 7. Wash station logs at Cherry Farms, 2017	
Month	Wash Stations Log
Jan	2
Feb	11
Mar	22
Apr	27
May	64
June	98
July	82
Aug	81
Sept	68
Oct	57
Nov	49
Dec	4
Total Sign-Ins	565

Site 2: Claridge Nursery: In August of 2015, Tropical Spiderwort was found in a field of Loblolly Pines at Claridge State Nursery (located in Wayne County approximately 5 miles from the CEFS Farming Systems Unit). A significant portion of the 8-acre field was found to be infested with TSW. The rest of the nursery was surveyed for the presence of TSW, and found to be clean. The positive field was sprayed with Gramoxone, burned with fire, and then bush-hogged and disked to eliminate biomass. Weather conditions did not permit fumigation of the field with Methyl Bromide until April 19, 2016 by TriEst Ag. The plastic remained on the fumigated field until June 7th. Rain from Hurricane Mathew resulted in the field being completely submerged. The field was re-surveyed by Ann Gallagher on November 23rd 2016, and was found to be clean of Tropical Spiderwort. No additional TSW plants were detected in 2017, and the field remained fallow for the entire season.

Site 3: Wake County Site: In September of 2015, an NCSU student alerted NCDA&CS to the presence of TSW in a private apartment complex in Raleigh, NC. Five NCDA&CS employees visited the site and hand rogued out the small patch (measuring 15 ft x 15ft) of plants. In October of 2015 an herbicide application of Dual Magnum and Roundup was applied to the site. The first seedlings emerged around June 2nd, of 2016. An herbicide spray was applied on July 11th, 2016 as well as in October of 2016. An additional two herbicide sprays were made in July and October of 2017. The site will continue to be monitored for several years to ensure eradication.

Wooly Frog's Mouth (*Philydrum lanuginosum*)

A plant identified as Woolly Frogs Mouth was reported to the NCDA&CS on August 8, 2016. This plant was growing in a private residence around a “Barrow Pit” located near the Holly Shelter by a member of the Wildlife Resources Commission. They were surveying the pond for the presence of the rare Gopher Frog, and noticed that the plant was taking over the pond in a very short amount of time.

A group of government representatives visited the site on August 22nd, 2016. Using information gathered at that time, a weed Risk Assessment was completed by Tony Koop (USDA-APHIS). It was determined that this was the first U.S. finding of this plant in a naturalized location, and that herbicide treatment was needed. A 5% solution of Rodeo (Aquatic glyphosate) was applied to the pond’s perimeter on October 4th, 2016. Good control was achieved to the plants growing above the water, and in the marginal areas, but poor control was observed in the submerged plants.



Figure 13. Steve Hoyle (NCSU Crop Science) collects Woolly Frogmouth Plants for utilizing in greenhouse herbicide screening, April 2017.



Figure 14. Woolly Frogmouth Plants growing in private pond in Pender Co., July 2017. The green, partially emergent plants, were sprayed in Fall of 2016. A more residual herbicide was used in 2017 to achieve better control.

Plants were collected in April 2017 for herbicide screening in the NCSU greenhouse. It was decided that a solution of imazapy and glyphosate may provide additional control to the remaining plants. Due to the growth of the frogs, herbicide treatment was delayed until October 18, 2017. Additional treatments will be made in 2018.

The Holly Shelter Gamelands was surveyed by vehicle by the Weed Specialist on October 4th, 2016, and a Pest Alert was produced and posted to the NCDA&CS website. This plant was reported to the NAPIS website on 09/21/2016 as “Wooly Waterlily”. As a result of the continued outreach efforts, it was discovered that this plant is also growing in areas of South Carolina and Florida. It is possible that it was sold in the nursery trade about 15 years ago.

Witchweed (*Striga asiatica*)

Witchweed (*Striga asiatica*) is a Federal Noxious Weed and a Class A State Noxious Weed in NC. It is an obligate parasite, and needs a grassy host such as corn, sorghum, millet, rice and several other warm season grasses. Heavy infestations of witchweed can eliminate yield from these crops, resulting in devastating economic losses. The presence of this quarantined pest also imposes a regulatory burden on crop production and on the movement of farm commodities, equipment, and other regulated articles. The witchweed eradication program includes an organized and effective set of survey, control and regulatory procedures developed through early USDA, APHIS research.

Specific objectives of the program include:

1) characterization of the infestation through survey; 2) control of existing infestations; and, 3) containment by preventing the movement of potentially infested articles out of established quarantine boundaries.

Survey – Survey is necessary to detect and verify the extent of Witchweed (Detection and Delimiting surveys), evaluate the effectiveness of eradication treatments on infested properties (Appraisal surveys), and verify eradication of Witchweed on sites released from quarantine (Released surveys). Additional survey of terminated acreage is required in order to confirm the long-term effectiveness of the eradication program. Survey is done through the growing season after host plants have started to grow from about the middle of June through the end of October or until the first frost.

Control – The objective of control treatments is to prevent Witchweed seed production and eliminate Witchweed seed from the soil. Herbicide treatments, hand pulling and disking help to control witchweed host plants and witchweed plants before they can flower and produce seed. Ethylene applications also help to deplete soil reserves of witchweed seed by encouraging germination and subsequent control by exposure to treatments or a non-host crop. Control treatments can be completed during the growing season and into the winter months provided soil moisture and temperature are favorable for soil fumigation.



Figure 15. Ray and Earl apply ethylene to a field formerly flooded for duck hunting at Sleepy Creek Lodge, Bladen county, NC. June 2016.

Regulatory – Regulatory activities aid in preventing the artificial spread of Witchweed from infested areas to non-infested sites. These regulatory functions facilitate the interstate and intrastate movement of agricultural commodities from Witchweed regulated areas.

Witchweed Eradication Program Data Compilation Description

A point system was developed for the program that provides a quantitative measure for moving fields from infested to a released status and from a released status to a terminated status. All control treatments and surveys are tracked in an *Access* database that automatically updates the point values for released fields and tracks assigned point values for infested fields. New or re-infested fields are added to the infested field list when witchweed is confirmed in new fields or in fields that have been previously released. The points assigned to infested fields are determined by the nature of the field and the control activities that were completed during the season. Once a field accrues five points it is advanced to “Release” status which means it is surveyed for a minimum of 10 years on a predetermined schedule that includes some skip years and either a spot survey or survey of the whole field (general survey) in the other years. A spot survey qualifies the field for 0.5 points and a general survey qualifies the field for 1.0 points. Once a field acquires a total of 10 points, of which 5 are assigned during the 10-year release survey period, it is terminated from the program.

The following summary tables show the status of acreage in NC as of the end of survey and treatment for the current growing season which usually occurs by mid-November each year. Since point values for a field are adjusted only once at the end of the growing season, it is not possible to obtain an accurate end of season account of field status until survey and treatment have ended for the year.

The following is a description of steps used to compile year-end summaries from the *Access* data base:

- Based on input from each inspector, infested field point values are manually adjusted to reflect current field conditions and treatments that were done during the year. In most instances fields will be advanced in point value. Some fields may qualify for release based on reaching a point value of 5. The new field point values are assigned at the end of the growing season after the first frost when it is assumed no more treatments for the year will be implemented and no new witchweed will be found.
- New fields are added to the data base and are assigned a new farm and/or field number. Re-infested field point values are changed to bring them back to values less than 5 so that they will be tallied as infested fields.
- After end of growing season adjustments, the data base is queried and standard reports are generated to provide updated statistics for acreages infested, released, surveyed and treated.

2017 Witchweed Program Discussion

We had an average spring and early summer field season this year, with temperatures staying cool until mid-season, where the year turned out to be very warm. The fall was normal. A killing frost



Figure 16: NCD&CS Witchweed employees (L to R) Bridget Lassiter, Carlie Averitt, James Bullard, Richard Smith, Cleveland Chavis, Earl Brewington and Justin Karl in Bladen County, September 2015.

occurred during the second week of November, and the last field surveys for Witchweed were completed during that time. During the field season (May through November), active fields were visited and treated every 14 days, thereby eliminating much of the risk that Witchweed would flower and produce more seed.

Several fields (equaling 142 acres), previously released or terminated fields were discovered to be re-infested with Witchweed. There are several ways that the fields could have been re-infested (contamination from equipment on the farm, movement of contaminated articles, or a long-lived seed bank), and we attribute the very astute actions of the plant pest inspectors in finding the fields. In many cases, the inspectors

stop to look at fields that have been released from the program (therefore not requiring a formal inspection) when they happen to be in the area inspecting other active fields. This situation emphasizes that this eradication program takes many years to be successful due to the very long seed viability (>15 years), and that prematurely ending the program could result in many new re-infested fields.

One farm in Cumberland County was sold late in the season to a new land-owner. That landowner started installing 5 new chicken houses on an actively infested field, unbeknownst to the NCD&CS

inspector, James Bullard. James discovered the work while visiting the field in September, and as a result, two pieces of earth-moving machinery were fumigated with Methyl Bromide before being moved off of the farm. In addition, four other pieces of equipment were washed with pressure-washers to remove any remaining soil from the equipment before moving. The farm will continue to be monitored for new infestations in 2018.



Figure 17: NCD&CS Witchweed employees wash an excavator used to build roads in an actively infested field. The machine was then fumigated to eliminate the risk of soil movement off of the farm.

2017 Witchweed Eradication Program Summary of Results

Table 1 summarizes acreage status for fields managed in the Witchweed Eradication Program in North Carolina. The number of infested acres increased slightly in 2017 as compared to 2016 due to a total of 142 new or re-infested acres added to the infested category.

487 acres were terminated from the program in 2017, but the resulting 3,447 acres are still subject to point system rules that include mandatory scheduled surveys.

Table 8. Total Acreage Status for the Witchweed Eradication Program

	2016	2017
Total Acres in Infested Category	1,181.40	1,266.00
Total Acres in Released Category	2,710.60	2,181.20
Total Acres Managed by Program	3,892.00	3,447.20
Total Acres Treated	1,530.14	1,701.41
Total Acres Surveyed	47,832.60	48,844.10
Acres Transferred from Infested to Release Category	104.70	57.30
Acres New or Re-Infested	<u>- 188.00</u>	<u>- 141.90</u>
Net Gain in Eradicated Acres	-83.30	-84.60

Other pertinent program data is summarized in [Table 9](#). Nine witchweed bounty payments were requested by temporary inspectors in 2017. Phytosanitary certificates are issued for movement of regulated articles moving out of the quarantine areas such as straw mulch used by the NC Department of Transportation. One hundred and four certificates were issued during 2017 compared to 87 issued in 2016. Witchweed was detected in 74 fields in 2017.

Table 9. Additional Statistics for the Witchweed Eradication Program

	2016	2017
Acres Treated by Contract	10	0
Counties now Infested in NC	5	5
Number of Witchweed Bounty Payments	12	9
Associated Witchweed Bounty Acreage	152.90	86.50
Number of Witchweed Infested Fields with Positive Sightings	53	74
Total Number of Witchweed Observations	232	227
Number of Phytosanitary Certificates Issued	87	104

The point status of infested fields provides an indication of how many years the field might remain in the program before being moved into the released category. Acreage currently with 4.0 or 4.5 points have a high probability of being released within the next 2 years. Table 10 shows infested field acreage by point value and County for 2016 and 2017.

Table 10. Infested Acreage by Point Value and County for 2016 and 2017

County		0-0.9 Acres	1-1.9 Acres	2-2.9 Acres	3-3.9 Acres	4-4.9 Acres	Infested Acres
Bladen	2016	248.60	26.60	67.30	128.60	118.10	589.20
	2017	236.00	116.90	78.80	74.50	133.70	639.90
Cumberland	2016	92.20	0.50	26.20	19.80	97.60	236.30
	2017	92.70	0	0	63.40	72.20	228.30
Pender	2016	13.00	0	0	6.00	0	19.00
	2017	26.30	0	0	6.00	0	32.30
Robeson	2016	134.60	0	14.30	91.60	84.10	324.60
	2017	0	0	177.50	18.40	157.30	353.20
Sampson	2016	0	0	0	12.30	0	12.30
	2017	0	0	0	0	12.30	12.30
Total	2016	488.40	27.10	107.80	258.30	299.80	1181.40
	2017	355.00	116.90	256.30	162.30	375.50	1266.00

In addition to infested acreage, another measure of the size of the Witchweed program is the number of infested farms and fields that are currently being managed with scheduled surveys and treatments. Table 11 shows the number of infested farms and fields by county for 2016 and 2017. There are currently 77 farms and 116 fields classified as infested (i.e. fields with fewer than 5.0 points) in the program. Including released fields for which surveys are still scheduled, there are a total of 329 fields still managed by the program (Table 15).

Table 11. Number of Infested Farms and Fields by County for 2016 and 2017

County		No. of Farms	No. of Fields	Infested Acres
Bladen	2016	34	59	589.20
	2017	34	63	639.90
Cumberland	2016	26	34	236.30
	2017	25	30	228.30
Pender	2016	2	2	19.00
	2017	3	3	32.30
Robeson	2016	13	19	324.60
	2017	14	20	353.20
Sampson	2016	2	2	12.30
	2017	2	2	12.30
Total	2016	77	116	1,181.40
	2017	77	116	1,266.00

Table 12 summarizes treatment acreage by crop type. Treated acreage is recorded for each treatment event and fields may get treated more than once during the season, so totals are cumulative. The type of crop planted into infested fields is an important indication of whether or not Witchweed is likely to emerge and be detected during the growing season.

Corn, Soybean and Idle land was in a 3-way tie for primary host crop in 2017. This is shift away from corn in previous years. However, most of the 2017 acreage is classified as “Other”. This represents one very large farm in Sampson county that allowed our inspectors access to “Food Plot” acres that had been infested for many years. Food plots are normally planted to a legume or seed crop, allowed to mature, and then flooded during the fall and winter months to allow for hunting of game and waterfowl. The land-owner allowed for the land to be drained, and we applied ethylene to all fields two times. Ethylene application is expected to reduce the eradication time by 1 to 3 years at this farm.

This table also indicates that a large portion of the treated acreage is idle land (usually pastures or abandoned garden plots). Idle land can easily be treated with herbicides, ethylene and disking, but garden spots are harder to manage because of proximity to residences and power poles.

Table 12. Summary of Treated Acreage by Crop Type for 2016 and 2017

Crop Name		No. of Acres Treated
Corn	2016	266.12
	2017	469.47
Soybean	2016	124.70
	2017	456.13
Idle	2016	349.41
	2017	469.93
Other	2016	743.51
	2017	305.88
Total Crop Acres Treated		
2016		1,483.74
2017		1,701.41

Table 13 describes Witchweed treatments that are applied to prevent witchweed from flowering and producing new seed, as well as those used to deplete reserves of seed still present in the soil. Ethylene applications are our main early-season control method. They help to hasten depletion of seed reserves by artificially stimulating Witchweed germination. In the absence of host plants, germinating Witchweed is unable to complete its life cycle and produce new seed (suicide germination). Disking (also completed in early-season) helps to remove grassy weed hosts and therefore also deny opportunities for additional Witchweed seed production. Hand pulling of emerged Witchweed plants before seed sets will also eliminate additional seed production, and is the main control method used in mid-late season. Herbicides are used to directly kill emerged Witchweed plants and to kill weedy hosts in false host crops (cotton) and host crops (corn or sorghum). Herbicides are also used to kill weeds on the fringes of fields to provide better conditions for Witchweed detection.

- The use of fumigants is rarely used in the program now due to new buffer zone requirements, NCDA&CS agency guidelines, and the high expense. Soil heat treatment, has been used in the past, but has not been utilized recently.
- Roundup Powermax® is the most commonly used herbicide due to the large percentage of soybeans and corn that are planted to Roundup-ready crops.

Table 13. Summary of Acres by Treatment Type for 2016 and 2017

Treatment Type		No. of Acres Treated	No. of Treatments
Disking <i>Treatment Code 39</i>	2016	745.80	138
	2017	606.00	95
Ethylene (Tractor and Hand) <i>Treatment Code 43</i>	2016	301.60	57
	2017	307.30	36
Hand Pulled <i>Treatment Code 61</i>	2016	104.53	205
	2017	94.39	201
Herbicide to Host <i>Treatment Code 94</i>	2016	339.10	31
	2017	544.30	40
Herbicide to Witchweed <i>Treatment Code 95</i>	2016	11.41	7
	2017	144.22	7
Herbicide (Survey Aid) <i>Treatment Code 96</i>	2016	27.70	7
	2017	5.20	2
Total Acres Treated		2016	445
		2017	381

The success of the Witchweed eradication program is largely dependent on the quality and quantity of field inspections completed during the growing season. Over 48,000 acres were surveyed during 2017 (Table 15). This is a decrease from 2016, partly due to the fact that the acreage (both active and released) is less this year than in past years.

We also began conducting Delimited surveys in fields that had been released from the Witchweed Eradication Program in Pender County. Some of these fields were released prior to 1995, when the USDA still held the program. It was expected that these fields would be clean of Witchweed, but in fact three positive finds were made in 2016. The remainder of the 112 fields were inspected in 2017, and no further positive detections were made. Those three fields were brought back into the Witchweed Eradication Program (moved from Terminated to Active), and will continue to be monitored.

Surveys determine the effectiveness of treatments on active fields (Appraisal Survey) and provide assurances that fields remain Witchweed-free between the time they are released until they are terminated from the program (Release Survey). Delimiting surveys are also completed on fields adjacent to infested or released properties to assure infestations remain contained. Detection surveys are also completed on fields which may be outside of the Witchweed quarantine area to ensure it has not spread outside of the designated quarantine area.

Table 14. Summary of Surveyed Acreage for 2016 and 2017

Category		Total Acres
Appraisal	2016	8,922.60
	2017	8,949.60
Release	2016	10,057.30
	2017	6,766.70
Delimiting	2016	24,626.30
	2017	28,276.60
Detection	2016	4,209.80
	2017	4,846.40
Regulatory	2016	16.60
	2017	4.80
Total Acres Surveyed		2016 47,832.60
		2016 48,844.10

2017 Program Overview

Table 15. Number of Farms and Fields by Point for each Officer

Infested										
Points	<i>Brewington</i>		<i>Chavis</i>		<i>Smith</i>		<i>Bullard</i>		Total	
	Fields	Ac	Fields	Ac	Fields	Ac	Fields	Ac	Fields	Ac
0 - 0.9	31	263.3	0	0	8	91.7	0	0	39	355
1.0 - 1.9	0	0	0	0	8	116.9	0	0	8	116.9
2.0 - 2.9	3	19.8	4	177.5	4	59	0	0	11	256.3
3.0 - 3.9	2	28.2	4	18.4	6	78.5	7	37.2	19	162.3
4.0 - 4.9	5	24.2	12	157.3	12	133.7	12	60.3	41	375.5
Sub Total	41	335.5	20	353.2	38	479.8	19	97.5	118	1266
Released										
5.0 - 5.9	5	21.4	0	0	6	30.9	14	65.8	25	118.1
6.0 - 6.9	3	2.5	2	22.5	4	33	4	69.5	13	127.5
7.0 - 7.9	14	155.5	11	140.1	12	157.6	16	360.5	53	813.7
8.0 - 8.9	17	107.5	14	158.9	6	37.4	9	132.1	46	435.9
9.0 - 9.9	21	226.9	15	91.8	19	198.7	19	168.6	74	686
Sub Total	60	513.8	42	413.3	47	457.6	62	796.5	211	2181.2
Total	101	849.3	62	766.5	85	937.4	81	894	329	3447.2

The following maps contain GPS collected data points for counties containing quarantined Witchweed fields. Data points were collected in 2014, but remain largely true to 2017.

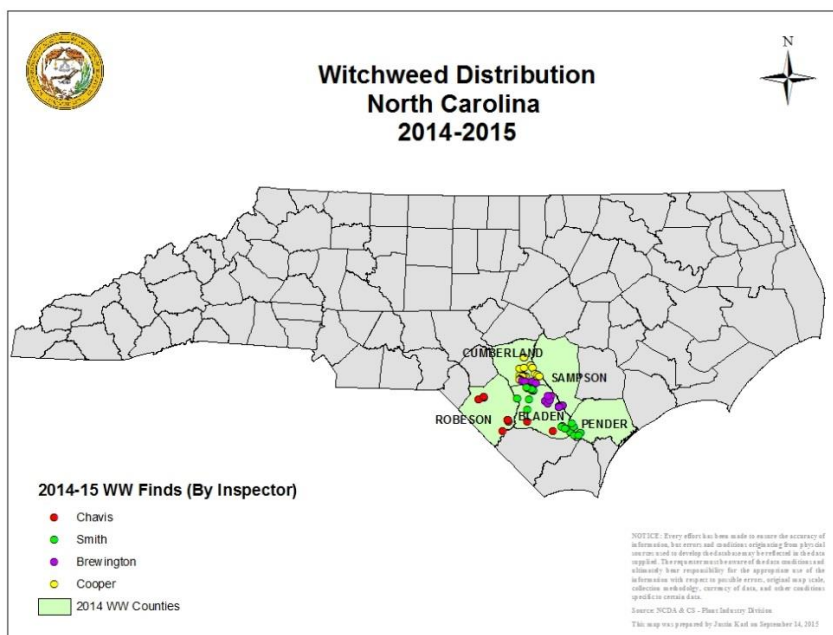


Figure 18. Witchweed Distribution in North Carolina by County and Inspector.

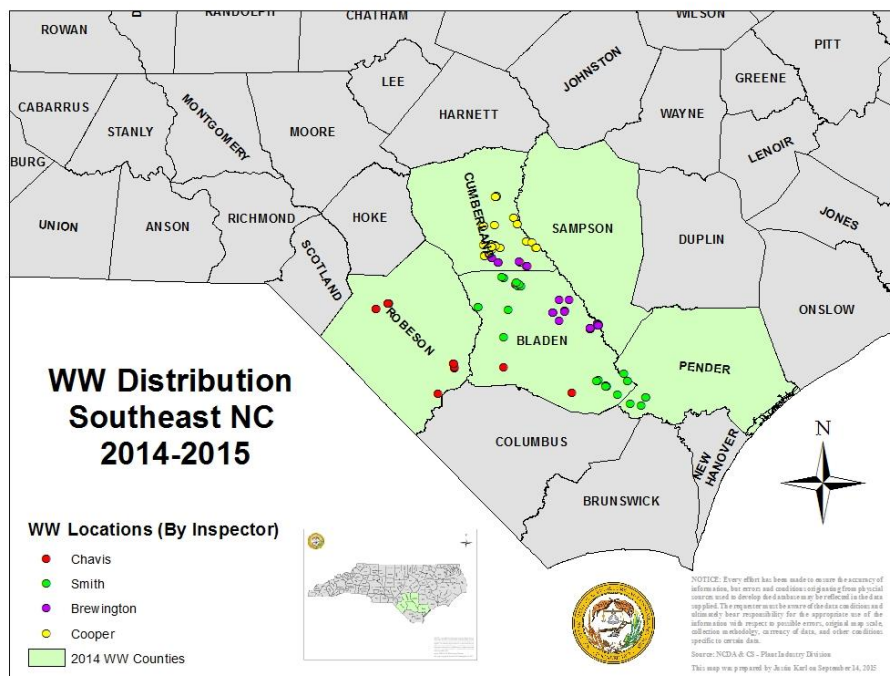


Figure 19. Witchweed Distribution in North Carolina by County and Inspector.

Seed and Fertilizer Section Accomplishments

The mission of the Seed and Fertilizer Section is to improve the profitability and sustainability of agriculture in the state by ensuring the seed, fertilizer, lime, and other soil additives offered for sale in North Carolina meet prescribed standards and are properly labeled.

The mission of this section is accomplished by:

- Ensuring that all locations that offer seed, commercial fertilizers, agricultural liming materials, landplaster, and soil additives for sale in the state are registered.
- Implementing a sound regulatory compliance program by conducting inspections and sampling of seed and fertilizer offered for sale in the state.
- Implementing seed purity, germination, and other specialized laboratory tests in support of the seed regulatory and service programs.
- Implementing a joint federal/state administered biotechnology permitting and inspection program.
- Conducting the fertilizer bioassay and endophyte testing programs.
- Coordinating activities of the N.C. Seed Board such that complaints regarding the failure of agricultural or vegetable seed to produce or perform as labeled or warranted are heard and responses are provided.

The Seed and Fertilizer Section includes 25 staff members with responsibilities and accountability for administration, field services and North Carolina Seed Lab functions. The total budget for the Seed and Fertilizer Program for 2016-17 was \$1,694,555 including a state appropriation of \$727,227 and receipts of \$967,328. Revenues included receipts from licenses, registration fees, and tonnage fees.

Seed and Fertilizer Field Programs

During the fiscal year 2016-17 the Seed and Fertilizer Section remained very active providing services to producers and individuals within North Carolina and some service to non-residents of the state. Administrative staff was responsible for issuing 4,689 licenses for business that sold wholesale and retail seed. During the 2016-17 fiscal year 618 fertilizer licenses were issued to companies manufacturing or distributing fertilizer products. These products were sold through chain and private retail outlets and through 215 farm supply outlets.

Seed and Fertilizer Field Staff are responsible for conducting inspections and sampling seed and fertilizer offered for sale in the state. The staff also implements a regulatory program to ensure full compliance with laws and regulations. An overview of program accomplishments is provided in Table 27.

Seed and Fertilizer Field Staff also provided support to the North Carolina Department of Transportation by collecting 313 samples from 36 seed lots to be utilized on highway projects.

The lab tests performed on these seed lots detected several violations and as such remain a critical part of the program.

Commodity prices on all major crops generally remained above the long-term average and this was reflected in additional tonnage being applied. Along with traditional fertilizers, producers also took advantage of animal and poultry waste to provide nutrients to their crops.

Table 34 Seed and Fertilizer Program Inspection and Regulatory Activities, FY 2015-16

Number of Seed and Fertilizer Dealer Visits:	5,879
Seed and Fertilizer Samples collected	
Official Seed Samples	2,149 (54,633 lots)
Official Fertilizer/Lime Samples	1,750 (41,778lots)
Regulatory Compliance Program	
Seed Stop Sales Issued	29
Seed Stop Sales Issued and Resolved on Site	1,095
Seed Stop Sales (N.C. Seed Lab)	160
Fertilizer Stop Sales Issued	69
Fertilizer Stop Sales Issued and Resolved on Site:	24

Table 35 and Table 36 provide additional information on fertilizer and lime samples taken by field staff and subsequently analyzed to ensure compliance with applicable statutes and regulations.

Table 35 Data of fertilizer samples analyzed for the current and previous fiscal years

FERTILIZER SAMPLING AND TONNAGE						
<u>Year</u>	<u>#Samples</u>	<u>#Compliant</u>	<u>%Compliant</u>	<u>Tonnage Reported</u>	<u>Tonnage Sampled</u>	<u>%Sampled</u>
2016-17	1,010	636	62.97	1,556,575	16,627	1.07
2015-16	899	605	67.30	1,504,612	13,809	0.92
2014-15	1,081	730	67.53	1,497,209	18,862	1.25
2013-14	1,374	1,058	77.00	1,509,378	22,309	1.48
2012-13	1,228	868	70.68	1,378,111	21,920	1.59
2011-12	1,195	876	73.31	1,243.164	56,762	1.5
2010-11	1,437	1,019	70.90	1,295.362	33,170	2.56
2009-10	1,651	1,141	69.11	1,251.026	26,539	2.12

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Table 36 Data of lime and landplaster samples analyzed for the current and previous fiscal years.

LIME SAMPLING AND TONNAGE						
<u>Year</u>	<u>#Samples</u>	<u>#Compliant</u>	<u>%Compliant</u>	<u>Tonnage Reported</u>	<u>Tonnage Sampled</u>	<u>%Sampled</u>
2016-17	680	505	74.26	909,685	31,767	3.49
2015-16	571	505	88.44	731,932	28,539	3.90
2014-15	587	510	86.88	741,188	28,757	3.88
2013-14	646	498	77.00	831,854	28,620	3.44
2012-13	692	615	88.87	825,596	33,941	4.11
2011-12	758	541	71.37	767,766	36,965	4.8
2010-11	895	724	80.90	793,925	43,680	5.50
2009-10	729	611	83.81	640,106	35,793	5.59

N.C. Seed Laboratory

The North Carolina Seed Laboratory is responsible for providing laboratory support for both the regulatory and service areas including the state's seed dealers, producers, university researchers and consumers. The work of this laboratory provides critical seed testing data needed to make management decisions regarding seed stock and for labeling purposes. For 2016-17, the North Carolina Seed Laboratory conducted 3,126 regulatory seed tests and 11,480 service seed tests. These tests involve required testing for purity and germination. Multiple tests are generally conducted on each of the samples submitted with 14,614 individual tests carried out. Additional special tests included tetrazolium, accelerated aging, cool test of cotton, cold test of hybrid corn, phenol, Round-up Ready™ tolerance, sand, and moisture testing. There were 568 special tests conducted during the fiscal year. All official regulatory samples taken during the fiscal year

2016-17 represent testing for a total of 45,768,134 pounds of seed offered for sale in North Carolina. See Figure 36 and Figure 37 for more information on the various seed tests performed in the laboratory.

The Seed and Fertilizer Section continued to implement the endophyte testing service. A number of grasses, including tall fescue and perennial ryegrass, contain a fungal endophyte which has a beneficial relationship with the grass host. The tall fescue endophyte, *Neotyphodium coenophialum* (previously *Acremonium coenophialum*), lives exclusively inside plants, and can only be detected through laboratory analysis. This endophyte has been proven to give the plant insect, disease and drought resistance, as well as enabling the plant to be more tolerant of overgrazing. Though very beneficial to tall fescue plants, this endophyte produces chemicals which are toxic to a variety of animals. In North Carolina, fescue toxicosis is especially a problem in horses and cattle. A total of 7 pasture samples were processed for producers, both in-state and out-of-state.

The staff of the North Carolina Seed Laboratory remains active in the Association of Official Seed Analysts and the Association of American Seed Control Officials. At the state level, program staff remains active in the North Carolina Seedsmen's Association and the North Carolina Crop Improvement Association.

Joint Collaboration with USDA, Biotechnology Regulatory Service Programs

Seed and Fertilizer Section staff worked with USDA, Biotechnology and Regulatory Services (BRS) to jointly administer a federal/state biotechnology and permitting program. Primary responsibilities included reviewing permits and acknowledgements provided through USDA-BRS for laboratory, greenhouse, and field tests of genetically engineered crops. For this period, NCDA&CS staff reviewed a total of 208 notifications and permits. A joint project with USDA-BRS continued during this period involving NCDA&CS staff conducting field inspections of *Notification and Permit Release Sites*, including pharmaceutical/industrial trials. During this time period there were 4 field inspections conducted by NCDA&CS field staff. As a prerequisite for participation in the project, all field staff were required to participate in training conducted by USDA-BRS focusing on work flow, confidential business information, and steps in effectively completing a field inspection.

North Carolina Seed Board

The responsibility of the North Carolina Seed Board is to review complaints from individuals who may have suffered damage from the failure of agricultural or vegetable seed to perform as labeled or warranted, or as a result of negligence. Performance issues related to seed purity, seed germination, varietal purity, percent weeds, inert material, other crop seed and test date are potential issues to be addressed by the Seed Board. For the 2016-17 fiscal year time period, the Seed board conducted an investigation of one complaint that was filed in June, 2016 for carrot seed

North Carolina Tobacco Variety Evaluation Program

The Tobacco Variety Evaluation Program continued in joint cooperation with N.C. State University. Samples from 30 flue-cured tobacco seed lots were obtained for planting grow-outs in the variety testing program. The Tobacco Seed Company approved for sale in North Carolina a total of 27 different varieties from four different seed companies.